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RESULTS OF THE SITE INVESTIGATION, PHASE II

at the

Paducah Gaseous Diffusion Plant
Paducah, Kentucky

owned and operated by

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APPENDIX 2B-3

Results of the Surface Radiation Survey of WMUs 1, 4, 7, 30, 91 and Selected Onsite Ditches

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SUBJECT: Results of the Surface Radiation Survey of WMUs 1, 4, 7, 30, 91, and Selected Onsite Ditches

PROJECT: ORO30888.FR

INTRODUCTION

A surface radiation survey was conducted from November 1990 through January 1991 of WMUs 1, 4, 7, 30, and 91, as well as the ditch south of WMUs 2 and 3 and the ditch south of WMUs 7 and 30, as shown in Figure 3-1. The surface radiation survey was conducted as part of the Phase II Field Reconnaissance Task.

The purpose of the radiation survey was to identify areas of surface radiological contamination and their boundaries and to differentiate between the beta and gamma radiation component.

This TM is divided into two sections. The first section describes the survey methodology, such as survey area and coverage, instrumentation and calibration, and quality assurance (QA). The second section summarizes the survey results according to location.

SURVEY METHODOLOGY

SURVEY AREA AND COVERAGE

The survey was to initially encompass WMUs 4, 7, 30, the ditches bordering the scrapyard (WMUs 12, 13, and 15), and the ditch on the southern border of WMUs 2 and 3. The scope was expanded to include WMU 1, WMU 91, and the extension of the ditch survey at WMUs 2 and 3 to the west perimeter fence. The survey was expanded to include WMUs 1 and 91 because of the planned activities at those locations, such as well installation and soil borings. The ditch south of WMUs 2 and 3 survey was extended to include the ditch segment south of WMU 91. The survey extended to the west perimeter fence so that the entire area was covered.

The WMUs were measured and flagged prior to the actual walkover survey. The grid coordinate system was established by tape measuring from the surveyed horizontal and vertical coordinates. The WMUs were pin-flagged in 50-ft × 5-ft grids. This grid system is tied to the PGDP coordinate system. The WMU's boundary, as defined by the coordinate system established for the radiation survey and the plant system, is shown in Table 3-1. Often, the survey extended beyond the actual WMU borders

Table 3-1
Radiation Survey WMU Boundary Coordinates and Corresponding PGDP Coordinates
PGDP Phase II Site Investigation

Location	Survey Coordinates		Plant Coordinates East	Plant Coordinates North
WMU No. 1	N8+00	E10+50	-1916.7	-7006.3
	N9+00	E10+00	-1911.2	-7058.2
	N10+50	E10+00	-1667.4	-7059.4
	N10+50	E15+50	-1660.6	-6509.4
	N9+00	E15+50	-1810.6	-6507.6
	N8+00	E13+50	-1913.1	-6706.3
WMU No. 4	N13+50	E15+50	-1148.1	-5875.1
	N8+75	E15+50	-1623.0	-5878.5
	N8+75	E9+00	-1618.4	-6528.3
	N13+50	E9+00	-1143.5	-6525.0
WMU Nos. 7 and 30	N12+25	E10+25	1001.1	-7252.8
	N12+25	E12+75	995.5	-7002.9
	N9+25	E12+75	695.6	-7009.6
	N9+25	E10+25	701.1	-7259.5
WMU 91	N10+50	E6+00	-976.8	-7206.0
	N10+50	E10+50	-980.9	-6755.7
	N9+50	E10+50	-1080.9	-6756.7
	N9+50	E6+00	-1076.8	-7206.9

taking into account natural boundaries or adjacent areas that may be influenced by the WMU.

The survey system established for the ditches was similar to the system used for the Phase I walkover survey of the creeks and ditches (see Technical Memorandum No. 17, January 4, 1991). The station 0-N coordinate was set at a location such that the survey would begin at the easternmost location of WMU 3 and then extend west to the perimeter fence as shown in Figure 3-1. The ditches were marked with pin flags in 50-ft increments along the length of the ditch. The point measurements alternated between the ditch banks and ditch center. For example, the first measurement was taken on the north bank, the second measurement at the ditch center, the third measurement on the south bank, the fourth measurement at the ditch center, and so on along the length of the ditch.

LOW-LEVEL GAMMA RADIATION WALKOVER MEASUREMENTS

The low-level gamma radiation survey was conducted with an Eberline SPA-3, which consists of a Sodium Iodide (NaI) Scintillation Crystal (2 in. $\times$ 2 in.) and photomultiplier tube. This detector is coupled with a count rate meter, either an ESP-1 or PRS-1. The SPA-3 detector is primarily used to detect gamma radiation because of its high gamma sensitivity [sensitivity of approximately 1,200 cpm per microRoentgens per hour (uR/hr) Ra-226]. The ESP-1 and PRS-1 are count rate meters that can be used with both the SPA-3 and G.M. detectors.

The WMUs were scanned with the SPA-3 detectors to determine the location of the elevated gamma radiation readings. WMUs 1, 7, and 30 were surveyed by walking with the low-level gamma detector held approximately 6 in. above the ground. The ditch south of WMUs 7 and 30 was surveyed in the same manner. Areas of elevated count rates (approximately 3 times background) were marked with pin flags, and shielded/ unshielded G.M. detector measurements were taken.

At other locations where the background gamma radiation was elevated due to gamma radiation emanating from nearby sources, such as the uranium cylinder storage yards, point measurements were generally taken at 25-ft intervals with a cone shield. A cone shield is a bell-shaped lead shield into which the SPA-3 detector is inserted. Maximum shielding (1-1/2 to 2 in. lead) surrounds the NaI detector and the photomultiplier tube and then tapers to approximately 1/2-in. lead at the bell lip. The distance between the NaI detector and the ground is 20 to 24 inches. The bell dimensions and the detector position within the bell allows for approximately 1 m^2 of ground surface to be surveyed. Cone-shield measurements were taken at WMU 4 and along the ditch south of WMUs 2 and 3.

G.M. DETECTOR MEASUREMENTS

The point shielded and unshielded G.M. detector measurements were taken at the four grid corners and at the center of each grid block throughout each WMU. Additional "biased" point measurements were taken at locations where elevated readings were identified during the gamma walkover survey. At WMU 91, only G.M. measurements were taken because of the close proximity of the uranium cylinder yard and time constraints.

For the ditch south of WMUs 2 and 3 and the ditch south of WMUs 7 and 30 (and railroad tracks), discrete G.M. measurements were taken at 50- and 25-ft intervals, respectively, along the ditch, alternating between the banks and the ditch center.

The measurements were conducted using thin-window ($\leq$2 mg/cm^2 HP-210 and 30 mg/cm^2 HP-270) G.M. detectors and portable Eberline ESP-1 and PRS-1 count rate meters. The HP-210 is primarily designed for contamination surveying, whereas, the HP-270 is used to measure exposure rates. The HP-210 is a "pancake type" G.M. detector. The HP-210 coupled with either a ESP-1 or PRS-1 count rate meter is used to obtain surface measurements of beta and gamma radiation levels. When the window is open (unshielded), it is useful for detecting beta particles (to ~40 kev), gamma radiation and some alpha particles (>3 kev). When measurements are taken with the window covered (shielded) with approximately 400 mg/cm^2 aluminum foil, the contribution of non-penetrating beta and low-energy gamma radiation is blocked. Therefore, the unshielded/shielded G.M. measurement is useful for differentiating between the beta and gamma radiation.

INSTRUMENTATION AND CALIBRATION

Each instrument was calibrated off the site at the Eberline instrument-calibration facility in Oak Ridge, Tennessee. Calibration certificates were issued for each instrument and probe. Table 3-2 lists the instruments used. Information on instrument calibration is in Attachment 3-A. The calibrations are traceable to the National Institute of Standards and Testing [NIST, formerly the National Bureau of Standards (NBS)]. Conversion of the SPA-3 count rate measurements (counts per minute, cpm) to exposure rate in uR/hr was determined by cross-calibration with a pressurized ionization chamber (PIC), using a Ra-226 source, and by field measurements. The PIC is a sensitive gamma exposure monitoring system designed to measure low level exposure rates and can be used to determine if exposure rate increases are due to plant operation, natural radiation levels, or a combination of both. Field PIC measurements were taken at various offsite locations, and the onsite measurements were taken at WMU No. 1 (~N10+50, E12+50). The PIC exposure rates and the corresponding SPA-3 count rates are given in Table 3-3.

Survey instruments were source-checked on the site daily before and after use to verify if instrument response was stable. The SPA-3 detector was source-checked with a Cs-137 (approximately 8 uCi, 1.78E7 dpm) source. The G.M. detectors were source-checked on the site with a Tc-99 (4.64E-3 uCi, 10,300 dpm) source.

Table 3-2 Radiological Survey: Instrumentation PGDP Phase II Site Investigation			
Detector		**Count Rate Meters**	
Model	**Serial No.**	**Model**	**Serial No.**
NaI Scintillator Detector			
SPA-3	EAC-15	ESP-1	2014
SPA-3	EAC-40	ESP-1	02401
SPA-3	EAC-140	ASP-1	1772
G.M. Thin-Window Detector			
HP-210	EAC-101	PRS-1	592
HP-210	EAC-102	ESP-1	275
HP-210	EAC-105	ESP-1	923
HP-270	CC-81, #1	ESP-1	02401

Table 3-3
PIC and SPA-3 Exposure Rate and Count Rate Intercomparison
PGDP Phase II Site Investigation

Location	SPA-3 (cpm)	PIC (uR/hr)	Conversion (cpm/uR-hr)
Background location at 19000-S Little Bayou Creek (LBC)	9,600 8,950	8.9 8.9	 1,042
Big Bayou Creek at 17250-N	7,038	6.5	1,083
LBC at: 4550-N 8150-S	 7,575 12,975	 7.3 9.3	 1,038 1,395
North/South Ditch at: 80-N 4600-N	 52,800 8,430	 26.2 8.1	 2,015 1,041
KPDES-001/LBC at 12297-N	38,000	17.1	2,222
KPDES-001/West Perimeter Fence	21,475	11.0	1,952
WMU No. 1 at ~N10+50, E12+50	130,020	80.0	1,625

MEASUREMENT OF BACKGROUND RADIATION

The natural background radiation level for each type of instrument was established during the Phase I walkover survey (see Technical Memorandum No. 19). Typical background radiation levels as detected by the SPA-3 can vary between 9,000 and 12,000 cpm. For the G.M. detector, typical background levels would be ~40 cpm (unshielded) and ~38 cpm (shielded). However, gamma background count rates can increase if there are nearby sources, such as the uranium cylinder storage yards. During the current study, background radiation levels were determined in the Eberline Field Support Trailer and in the field. Background levels specific to survey locations are delineated in the survey results tables (see Attachment 3-B and 3-C).

QUALITY ASSURANCE

The survey instruments were source-checked daily both prior to and after the field surveys. In addition, approximately 10 percent of the G.M. measurements taken at WMUs 4, 7, 30, and 91 were duplicated and reported, as shown in Attachment 3-C.

SUMMARY OF FINDINGS

The results of this study are described according to area surveyed. Locations of the WMUs 1, 4, 7, 30, 91, and ditches are shown in Figure 3-1. The results from the gamma walkover survey and the G.M. measurements are outlined in Attachments 3-B and 3-C, respectively. Tables of the gamma walkover survey and G.M. measurement coordinates with the corresponding PGDP coordinates are given in Attachment 3-D. The first subsection outlines results for the WMU surveys, and the second subsection describes the ditch surveys.

Two criteria were used to identify surface contamination. The baseline criterion used to indicate contamination was three times background. This criterion takes into account background variation and still indicates that surface contamination is present. The second criterion was used to identify a "significantly elevated reading," which is usually associated with localized contamination. For both the gamma (SPA-3) and G.M. measurements, "significantly elevated" readings were defined as approximately 10 times background.

WMU NO. 1

WMU No. 1 is the C-747-C oil land farm and is located in the extreme west central area of the plant site. The oil landfarm consisted of two plots of approximately 1,125 ft^2 each. The landfarm was used from 1975 to 1979 for the biodegradation of waste oils that were possibly contaminated with trichloroethylene/ trichloroethane (TCEA), uranium, and PCBs.

The results of the gamma and beta/gamma walkover survey are shown in Figure 3-2. The gamma survey revealed 36 "significantly elevated readings" ranging from 100k cpm to 4 million cpm (k stands for 1,000 cpm). The locations of these readings and the corresponding G.M. measurements are outlined in Table 3-4.

The majority of the significantly elevated areas were in or near the north perimeter ditch, which separates WMU No. 1 from the uranium cylinder storage yard. Other significantly elevated areas were identified at the bottom of the ditch west of WMU 1.

Systematic beta/gamma measurements were taken at the grid corners and center, as shown in Figure 3-2. Biased measurements were taken at the 36 locations. At a number of locations the unshielded and shielded measurements were comparable; the shielded measurements were lower than the unshielded, but not to background. The SPA-3 measurements and the G.M. measurements at these locations indicate that gamma emitters are the primary contaminant.

An area of approximately 4 ft^2 with significantly elevated radiation levels was found southwest of the N10+50, E12+50 grid stake. The gamma measurements were >3 million cpm on contact with the ground surface, and the HP-270 indicated an exposure rate of 3 to 5 mR/hr. The ditch south of this area (~N10+00, E12+50) also exhibited elevated readings (see Attachment 3-B). An area east-northeast of WMU No. 1 also exhibited significantly elevated readings; this area is south of a row of cylinders located at the east side of the cylinder yard.

WMU NO. 4

WMU No. 4 contains the C-747 Contaminated Burial Yard. It is located in the western area of the plant immediately south of Virginia Avenue (between 4th and 6th Streets). The burial yard consists of two pits covering an area of approximately 8,300 ft^2. Solid wastes disposed at C-747 are contaminated with natural or slightly depleted uranium from the UF_6 Feed Plant (C-410). The C-747 Contaminated Burial Yard may also have been a source of Technetium-99 (Tc-99) from disposed uranium contaminated with Tc-99.

Systematic cone-shielded gamma measurements were taken at 25-ft increments throughout WMU 4, as shown in Figure 3-3. The cone-shield was used because of the proximity of uranium cylinder yards located north and west of WMU 4. Biased readings were obtained where localized elevated readings were observed and along the center of the west perimeter and north perimeter ditches. The east perimeter ditch was located on an even 25-ft grid line; therefore, biased measurements were not necessary. Elevated readings were detected in all three perimeter ditches, but did not exceed the 3 times background criterion. Localized contamination was detected within WMU No. 4, particularly along the southern edge of WMU 4, approximately N9+50, E9+75 to E12+00 (~13.2k to 31.2k cpm).

Table 3-4
Summary of Significantly Elevated SPA-3 and G.M. Reading Locations
WMU 1
PGDP Phase II Site Investigation

Location	Gamma (cpm)	Beta/Gamma (Unshield/Shield) (cpm)	Location	Gamma (cpm)	Beta/Gamma (Unshield/Shield) (cpm)
N10+30, E10+03	200k	507/359	N10+50, E12+25	400k	825/706
N10+45, E10+00	180k	417/294	N9+79, E12+47	230k	3989/393
N10+27, E10+17	200k	228/198	N10+36, E12+45	350k	659/417
N10+30, E10+19	290k	483/367	N10+34, E12+47	450k	983/539
N10+32, E10+25	600k	1240/1023	N10+34, E12+50	400k	579/412
N10+35, E10+30	500k	1184/952	N10+48, E12+47	4 mill+	11712/7535
N10+47, E10+22	500k	1184/952	N9+56, E12+70	102k	395/123
N10+33, E10+40	300k	566/595	N10+36, E12+65	270k	366/332
N10+44, E10+70	160k	501/342	N10+42, E12+65	178k	340/225
N10+30, E11+60	10k	198/89	N10+48, E12+69	340k	327/198
N10+35, E11+70	100k	196/110	N9+64, E13+09	124k	433/155
N10+35, E11+75	100k	162/114	N9+64, E+13+14	203k	927/296
N10+35, E11+77	100k	133/102	N10+50, E13+38	441k	792/715
N10+35, E11+90	100k	171/93	N10+25, E15+03	175k	265/110
N10+35, E11+98	150k	165/120	N10+45, E9+85	790k	794/647
N10+34, E12+00	130k	226/117	N10+33, E9+86	220k	235/161
N10+34, E12+23	800k	1042/748	N10+51, E12+68	650k	1006/884
N10+36, E12+25	1 mill+	1228/1030	N10+51, E14+14	121k	98/96

Note: See Attachment 3-C for intercomparison readings.

Ditch Locations:

North Ditch ~N10+00, N10+50.
West Ditch ~E10+00, E10+50.
Southwest of ~10+50, E12+50, an area of ~4 ft exhibited significantly elevated readings; the gamma measurement >3 million cpm, and the HP-270 between 3-5 mR/hr.

G.M. (shielded/unshielded) measurements were taken on all the 50-ft grid intersections and at the center of each grid, as shown in Figure 3-3. Locations of elevated readings are shown in Table 3-5.

The grid line south of Virginia Avenue (N13+50) showed several >100 cpm unshielded readings. In most cases, when the elevated unshielded readings were observed, the shielded readings were at or near background levels. This phenomena would indicate that the primary contaminants were beta emitters, such as Tc-99.

The G.M. measurements detected elevated count rates throughout the center of the west perimeter ditch (~N9+37), north perimeter ditch (~N13+40), and in localized areas in the east perimeter ditch (~E15+25). At one location (N8+92, E9+60), the observed elevated reading, 868 cpm (unshielded) and 720 cpm (shielded), indicated that gamma emitting radionuclides were present.

WMU NOS. 7 AND 30

WMUs No. 7 and 30 consist of the C-747-A Burial Ground and C-747 Burn Area, respectively. They are located in the extreme northwest corner of the PGDP. The C-747-A Burial Ground (WMU 7) was used for the disposal of uranium-contaminated material, including material from the C-410 Feed Plant. It is suspected to be a source of Tc-99 contamination. The C-747 Burn Area was used from 1951 to 1970 for burning combustible material.

Figure 3-4 illustrates the coordinate system that incorporated both WMUs 7 and 30 and the extent of contamination observed during the walkover survey. The crushed drum mound located in the southeast corner of WMU 7, limited the extent of the survey. A near surface gamma survey was performed over accessible areas of WMUs 7 and 30.

Gamma readings ranged from background to >1.5 million cpm. Greater than 3 times background readings were observed in approximately 60 percent of the grid blocks surveyed, as shown in Figure 3-4. At least 85 significantly elevated readings were observed during the gamma walkover survey. Yellow and green stones, possibly uranium oxides, were visible on the surface in several areas, as indicated in Attachments 3-B and 3-C.

G.M. (shielded/unshielded) measurements were also taken at all accessible nodes and grid centers, as shown in Figure 3-4. Biased measurements were also obtained at the 85 significantly elevated reading locations. Readings ranged from background to >2 million+ cpm (unshielded) and 27k cpm (shielded). These locations and the corresponding gamma and beta/gamma readings are shown in Table 3-6. Based on the results, both beta and gamma emitters are present. In most cases, the shielded G.M detector reduces the count rate, but not to background levels.

Elevated and significantly elevated G.M. measurements also were observed throughout the length of the swale immediately south of WMU Nos. 7 and 30, as shown in

Table 3-5
Summary of Elevated G.M. Measurement Locations
WMU 4
PGDP Phase II Site Investigation

Location	Unshielded (cpm)	Shielded (cpm)	Location	Unshielded (cpm)	Shielded (cpm)
N8+92, E9+60	868	720	N13+50, E12+50	122	36
N10+25, E9+25	124	52	N13+50, E13+00	101	44
N10+75, E9+25	103	53	N13+50, E13+50	112	43
N11+75, E9+25	226	62	N13+50, E14+00	137	55
N12+25, E9+25	172	43	N13+50, E14+50	117	48
N12+75, E9+25	119	56	N13+50, E15+00	111	40
N13+25, E9+25	160	49	N10+25, E15+25	109	43
N9+50, E10+00	118	46	N10+75, E15+25	99	52
N9+50, E11+00	158	64	N11+75, E15+25	113	53
N13+50, E11+50	125	48	N12+25, E15+25	140	42
N13+50, E+12+00	111	47			

Ditch Locations:

North Ditch ~N13+40
East Ditch ~E15+25
West Ditch ~E9+37

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Table 3-6
WMU Nos. 7 and 30--Elevated Measurements
PGDP Phase II Site Investigation
(page 1 of 2)

Location	Gamma (cpm)	Beta-Gamma (Unshielded)	Beta-Gamma (Shielded)
N-10+53, E-10+78	1M	200,787	19,333
N-9+94, E-10+92	120K	1,074	266
N-9+72, E-11+12	70K	651	106
N-10+09, E-11+97	124K	387	126
N-10+06, E-12+05	177K	768	142
N-11+04, E-12+18	38K	213	60
N-9+98, E-12+78	35-37K	388	73
N-9+70, E-13+08	60K	540	50
N-12+04, E-13+25	140K	782	313
N-9+87, E-13+85	360K	7,842	786
N-10+34, E-13+85	45K	40,163	2,318
N-9+80, E-14+05	575K	142,504	13,346
N-10+40, E-14+40	200K	866	331
N-11+38, E-14+42	40K	568	74
N-11+75, E-14+50	93K	951	120
N-9+91, E-14+52	120K	885	200
N-10+57, E-14+50	31K	691	96
N-10+99, E-14+69	78K	174	95
N-11+48, E-14+85	430K	5,351	796
N-12+01, E-14+74	110K	3,854	417
N-10+19, E-14+95	250K	1,396	537
N-11+75, E-15+01	240K	8,602	289
N-9+90, E-15+35	400K	92,648	6,427
N-10+50, E-15+30	1M+	153,156	15,080
N-10+58, E-15+25	970K	101,636	10,381
N-11+37, E-15+19	500K	16,906	1,390
N-12+04, E-15+10	90K	630	112
N-10+76, E-15+85	375K	124,156	13,865
N-10+59, E-15+65	290K	17,852	1,248
N-9+75, E-15+99	950K	139,388	16,420
N-11+47, E-15+90	200K	2,444	513
N-11+62, E-15+92	170K	768	224
N-9+85, E-16+48	650K	1,649	1,306
N-10+37, E-16+44	360K	146,214	14,002
N-10+68, E-16+49	220K	69,194	5,280
N-11+75, E-16+42	180K	3,086	300
N-10+47, E-16+60	330K	157,074	17,393
N-10+98, E-16+68	570K	151,859	16,346
N-9+75, E-16+73	310K	2,401	864
N-11+30, E-16+70	220K	3,382	768
N-11+65, E-16+76	330K	12,340	1,175
N-12+01, E-16+75	55K	323	97
N-10+18, E-17+18	330K	686	475
N-10+62, E-17+08	300K	36,431	2,878
N-11+47, E-17+02	850K	39,263	2,717
N-9+85, E-17+35	900K	218,845	27,142

Table 3-6
WMU Nos. 7 and 30--Elevated Measurements
PGDP Phase II Site Investigation
(page 2 of 2)

Location	Gamma (cpm)	Beta-Gamma (Unshielded)	Beta-Gamma (Shielded)
N-11+54, E-17+49	750K	143,864	10,871
N-12+38, E-17+45	50K	398	111
N-9+77, E-17+51	1.7M	149,058	21,439
N-10+30, E-17+56	140K	931	432
N-11+00, E-17+56	40K	268	69
N-11+41, E-17+65	1.3M	111,381	5,648
N-11+51, E-17+70	860K	105,910	11,653
N-12+00, E-17+99	80K	3,922	367
N-9+85, E-18+20	110K	39,828	5,728
N-10+49, E-18+35	500K	144,186	16,041
N-10+75, E-18+35	350K	70,729	6,160
N-11+45, E-18+15	240K	6,944	1,675
N-11+75, E-18+15	890K	36,468	4,297
N-12+02, E-18+49	810K	216,138	27,993
N-9+75, E-18+63	83K	3,945	326
N-10+75, E-18+80	200K	65,625	3,334
N-11+49, E-18+62	100K	4,194	348
N-11+98, E-18+80	1.1M	23,510	4,193
N-12+05, E-18+75	430K	17,836	2,815
N-10+85, E-19+25	170K	11,138	809
N-11+15, E-19+25	45K	958	135
N-11+65, E-19+10	110K	2,463 (2,564)[b]	270 (269)[b]
N-12+04, E-19+12	43K	685	102
N-11+48, E-19+85	35K	258 (271)[b]	84 (91)[b]
N-11+70, E-19+55	220K	6,409	414
N-11+20, E-20+25	260K	4,190 (4,110)[b]	435 (438)[b]
N-11+70, E-20+15	125K	675	200
N-12+02, E-20+47	115K	3,325	268
N-11+45, E-20+99	110K	635	200
N-11+92, E-20+52	600K	3,435	644
N-10+49, E-21+01	760K	175,536	17,981
N-10+59, E-21+00	530K	152,046	12,097
N-12+01, E-20+95	200K	8,449	210
N-11+30, E-21+51	130K	3,631	266
N-11+49, E-21+48	167K	5,736	474
N-11+70, E-21+45	200K	6,434	509
N-11+90, E-21+51	315K	5,412	661
N-12+02, E-21+53	400K	37,346	1,423
N-12+15, E-21+46	120K	3,656	268

[a]Does not include the North Perimeter Ditch (see Technical Memorandum No. 17) and South swale (see Attachments 3-B and 3-C).
[b]Measurements in parenthesis are quality control readings.

Ditch locations ~N12+00 (North Perimeter Ditch), ~N9+67 (South Ditch).
M = million cpm.
K = 1,000 cpm.

Table 3-7. These elevated readings were seen on both banks and swale center. At certain locations, measurements were unobtainable at the center due to standing water (N9+67, E18+75 to E21+25). Beta emitters appear to be the primary contaminant; however, gamma emitters were also present.

WMU NO. 91

WMU No. 91 is the UF_6 cylinder drop test area. It is located in the extreme west central area of the plant on the southern edge of the C-745-B Cylinder Yard. The drop test pad is still intact. The survey extended beyond the boundary of WMU 91 to include the monitoring well locations (MW-158, 159, and 160) as shown in Figure 3-5. Only G.M. (shielded/unshielded) measurements were taken. Three elevated readings were detected at this location, as shown in Table 3-8.

The shielded readings were near background. This indicates that a beta emitter such as Tc-99 may be the primary contaminant. The only exception may be at the N9+50, E10+50 location, where some gamma activity was present.

DITCHES

Ditch South of WMUs 2 and 3

Cone-shielded gamma readings and G.M. (shielded/unshielded) measurements were obtained along the length of the ditch south of WMUs 2 and 3. This survey began at the east entrance of C-404 (WMU No. 3) and extended to the west perimeter fence, as shown in Figure 3-6. This ditch also passes south of WMU 91. WMU 2 consists of the C-749 Uranium Burial Ground, and WMU 3 consists of the C-404 Low-Level Radioactive Waste Burial Ground. The majority of waste received in WMU 2 consisted of pyrophoric forms of uranium metal, uranium oxides, and uranyl fluoride solutions. WMU 3 was contaminated with Tc-99 and uranium-contaminated solid waste.

Cone-shield gamma (SPA-3) measurements were taken at 25-ft intervals. Locations of elevated gamma readings are given in Table 3-9. Localized areas of contamination were observed along the ditch banks, but the center (bottom) of the ditch exhibited readings that were consistently elevated.

The G.M. measurements were obtained at 50-ft intervals, alternating between the banks and the center of the ditch. Elevated readings were also obtained and were located predominately at the center (bottom) of the ditch, as shown in Table 3-10.

Based on the measurements, it appears that both beta and gamma emitters are present, particularly in the ditch center. The contamination appears to be distributed throughout the length of the ditch.

Table 3-7
Elevated G.M. Measurements
Swale South WMUs 7-30[a]
PGDP Phase II Site Investigation
(page 1 of 2)

Location	Side	Beta-Gamma Unshielded (cpm-gross)	Beta-Gamma Shielded (cpm-gross)
N9+67, E11+00	South	150	40
N9+67, E11+25	Center	1,163	39
N9+67, E11+50	North	255	53
N9+67, E11+75	Center	733	89
N9+67, E12+00	South	547	75
N9+67, E12+25	Center	719 (683)[b]	84
N9+67, E12+50	North	191	48
N9+67, E12+75	Center	487	75
N9+67, E13+25	Center	575	93
N9+67, E13+50	North	150	41 (34)[b]
N9+67, E13+75	Center	292	45
N9+67, E14+25	Center	1,742	204
N9+67, E14+50	North	1,688	182
N9+67, E14+75	Center	807	134
N9+67, E15+00	South	1,526 (1,562)[b]	136
N9+67, E15+25	Center	2,375	253
N9+67, E15+50	North	5,710	392
N9+67, E15+75	Center	952	157
N9+67, E16+00	South	1,637	185
N9+67, E16+25	Center	2,860	214 (186)[b]
N9+67, E16+50	North	2,598	207
N9+67, E16+75	Center	3,740	359
N9+67, E17+00	South	939	121
N9+67, E17+25	Center	1,055	111
N9+67, E17+50	North	19,657	1,972
N9+67, E17+75	Center	1,008	119
N9+67, E18+00	South	197	45
N9+67, E18+25	Center	1,001	106

DEN/177R/005.51

Table 3-7
Elevated G.M. Measurements
Swale South WMUs 7-30[a]
PGDP Phase II Site Investigation
(page 2 of 2)

Location	Side	Beta-Gamma Unshielded (cpm-gross)	Beta-Gamma Shielded (cpm-gross)
N9+67, E18+50	North	910(883)[b]	124
N9+67, E20+00	South	430	51
N9+67, E20+50	North	538	71
N9+67, E21+00	South	345	56
N9+67, E21+50	North	3,470	376

[a]Not to be confused with following discussion of ditch south of WMUs 7 and 30 and the railroad tracks.
[b]Quality control measurements.

Table 3-8 Elevated G.M. Measurements WMU 91 PGDP Phase II Site Investigation		
Location	**Beta/Gamma Unshielded (cpm)**	**Beta/Gamma Shielded (cpm)**
N10+50, E8+00	113	69
N9+50, E10+50	172	84
N10+50, E10+50	106	58

Table 3-9
Elevated Gamma Measurements Along the Ditch
South of WMUs 2 and 3
PGDP Phase II Site Investigation

Location	Side	Gamma (cpm)	Location	Side	Gamma (cpm)
175-W	Center	30k	975-W	Center	48k
200-W	North	32k	1075-W	Center	57k
400-W	North	44k	1025-N	Center	56k
425-W	Center	48k	1150-W	South	52k
475-W	Center	52k	1175-W	Center	54k
500-W	North	32k	1225-W	Center	54k
525-W	Center	104k	1275-W	Center	85k
575-W	Center	104k	1325-W	Center	84k
625-W	Center	30k	1375-W	Center	92k
675-W	Center	32k	1425-W	Center	112k
725-W	Center	35k	1475-W	Center	64k
825-W	Center	41k	1525-W	Center	78k
875-W	Center	48k	1575-W	Center	48k
925-W	Center	56k			

DEN/177R/006.51/2

Table 3-10
Elevated G.M. Measurements Along the Ditch
South of WMUs 2 and 3
PGDP Phase II Site Investigation

Location	Side	Beta/Gamma Unshielded (cpm)	Beta/Gamma Shielded (cpm)	Location	Side	Beta/Gamma Unshielded (cpm)	Beta/Gamma Shielded (cpm)
50-W	Center	186	74	1050-W	Center	330	88
150-W	Center	174	50	1075-W	Center	196	94
200-W	North	106	84	1150-W	South	326	278
400-W	North	556	106	1200-W	Center	234	164
450-W	Center	160	88	1300-W	Center	176	60
550-W	Center	216	80	1350-W	South	144	64
650-W	Center	562	98	1400-W	Center	420	188
750-W	Center	230	88	1500-W	Center	554	118
850-W	Center	214	114	1600-W	Center	166	104
950-W	Center	320	110				

DEN/177R/006.51/3

Ditch South of WMUs 7 and 30

A walkover gamma survey and point beta/gamma measurements were performed along the ditch south of WMUs 7 and 30 and south of the railroad tracks, as shown in Figure 3-6. The survey of this ditch originally was to extend past the scrapyards (WMUs 12, 13, and 15), but a fenced security area prevented the continuation of the survey. Therefore, the survey began at the West Patrol Road and ended approximately 500 ft east, where the ditch enters the fenced security area surrounding the C-747-C scrapyard. This survey should not be confused with the survey of the swale on the south side of WMUs 7 and 30, which immediately borders these units, as shown in Figure 3-4. Results from that ditch survey are previously described in the WMUs 7 and 30 subsection.

For the gamma walkover survey, elevated count rates were consistently observed in the center of the ditch (25k to 40k cpm) and extended approximately halfway up the north bank of the ditch. Elevated G.M. (unshielded/shielded) readings were observed in the center of the ditch (N9+15) at six locations, as shown in Table 3-11.

At the center of the ditch, a beta emitter(s) appears to be the predominate source of contamination based on the G.M. measurements. At N9+15, E13+00 and, to a lesser degree, N9+15, E14+50, the shielded reading is above background, indicating that a gamma emitter(s) is present. Two culverts ran under the railroad tracks at approximately E12+00 and E12+50; these may have contributed to the contamination. No elevated readings were detected on the south bank or in the depressed area immediately west of the Patrol Road.

CONCLUSIONS

This Technical Memorandum presents the results of the gamma and the beta/gamma radiation surveys of the WMUs 1, 4, 7, 30, and 91, and the ditches south of WMUs 2 and 3 and WMUs 7 and 30. The purposes of these surveys were for (1) identifying areas of contamination and their boundaries, and (2) differentiating between the beta and gamma radiation component. The conclusions that can be made on the basis of the Phase II radiation survey are as follows:

- The radiation survey of WMU No. 1 identified several significantly elevated readings. The majority of contamination appeared to be in or near the north perimeter ditch and at the bottom of the west ditch. Based on this survey, a gamma emitter(s) is likely to be the primary contaminant.

- At WMU No. 4, elevated gamma survey readings were observed primarily in the surrounding ditches and along the southern edge of WMU No. 4, but did not exceed the 3 times background screening

Table 3-11
Elevated G.M. Measurements Along the Ditch
South of WMUs 7 and 30
PGDP Phase II Site Investigation

Location	Side	Beta/Gamma Unshielded (cpm)	Beta/Gamma Shielded (cpm)
N9+15, E10+50	Center	115	50
N9+15, E11+00	Center	187	50
N9+15, E12+00	Center	111	53
N9+15, E13+00	Center	344	80
N9+15, E14+00	Center	175	53
N9+15, E14+50	Center	292	60
N9+15, E15+00	Center	144	38

criteria. Only one elevated reading located at N9+50, E9+75 was observed that fit the criterion. The G.M point measurements indicated beta emitters are the predominate source of contamination, with the exception at N8+92, E9+60 where elevated shielded and unshielded count rates indicated that a gamma emitter is present.

- WMUs 7 and 30 was found to have surface contamination in numerous areas and locations, which in some cases greatly exceeded the 3 times background criteria. Yellow and green uranium oxides were visible on the surface in several areas. Based on the gamma (SPA-3) and G.M. measurements, both gamma and beta emitters are present.

- Only three elevated G.M. measurement readings were observed at WMU No. 91. A beta emitter is probably the primary contaminant.

- Localized areas of contamination were observed along the banks of the ditches south of WMUs 2 and 3. However, the center of the ditch exhibited readings that were consistently elevated throughout the length of the ditch. Based on the data, both beta and gamma emitters are present.

- The ditch south of WMUs 7 and 30 and the railroad tracks consistently exhibited elevated readings at the center (bottom) of the ditch, and the gamma survey indicated that the elevated readings were detected approximately halfway up the north bank, but were not observed on the south bank. The G.M. measurements indicated that a beta emitter is the primary source of contamination at 6 locations.

REFERENCES

Technical Memorandum No. 17, "Results of the Radiological Walkover Survey of Little Bayou Creek, Big Bayou Creek, and Plant Ditches," January 4, 1991, ORO28178.TM.

Phase II Site Investigation Work Plan, for PGDP, U.S. DOE and Martin Marietta Energy Systems, June 1990.

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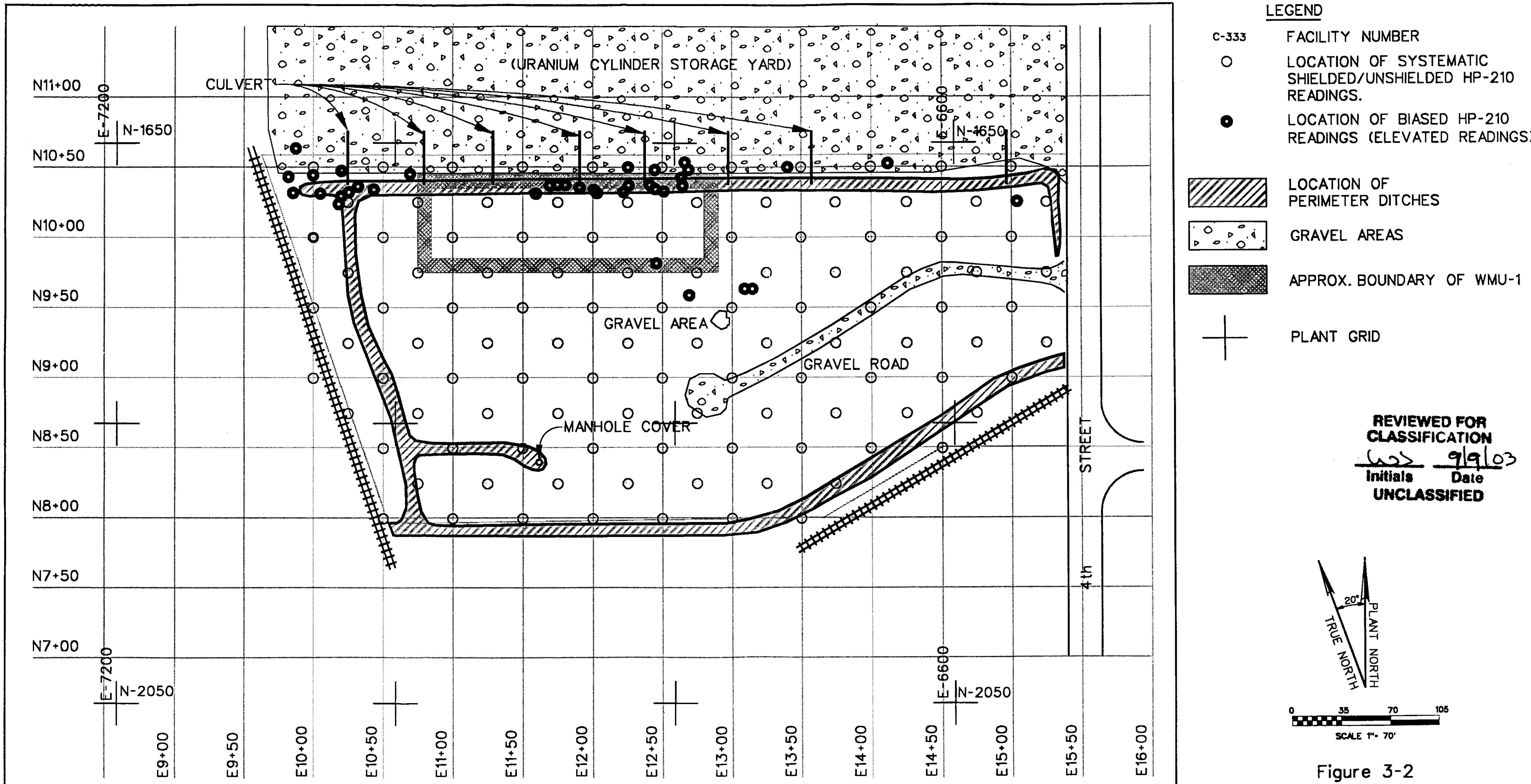

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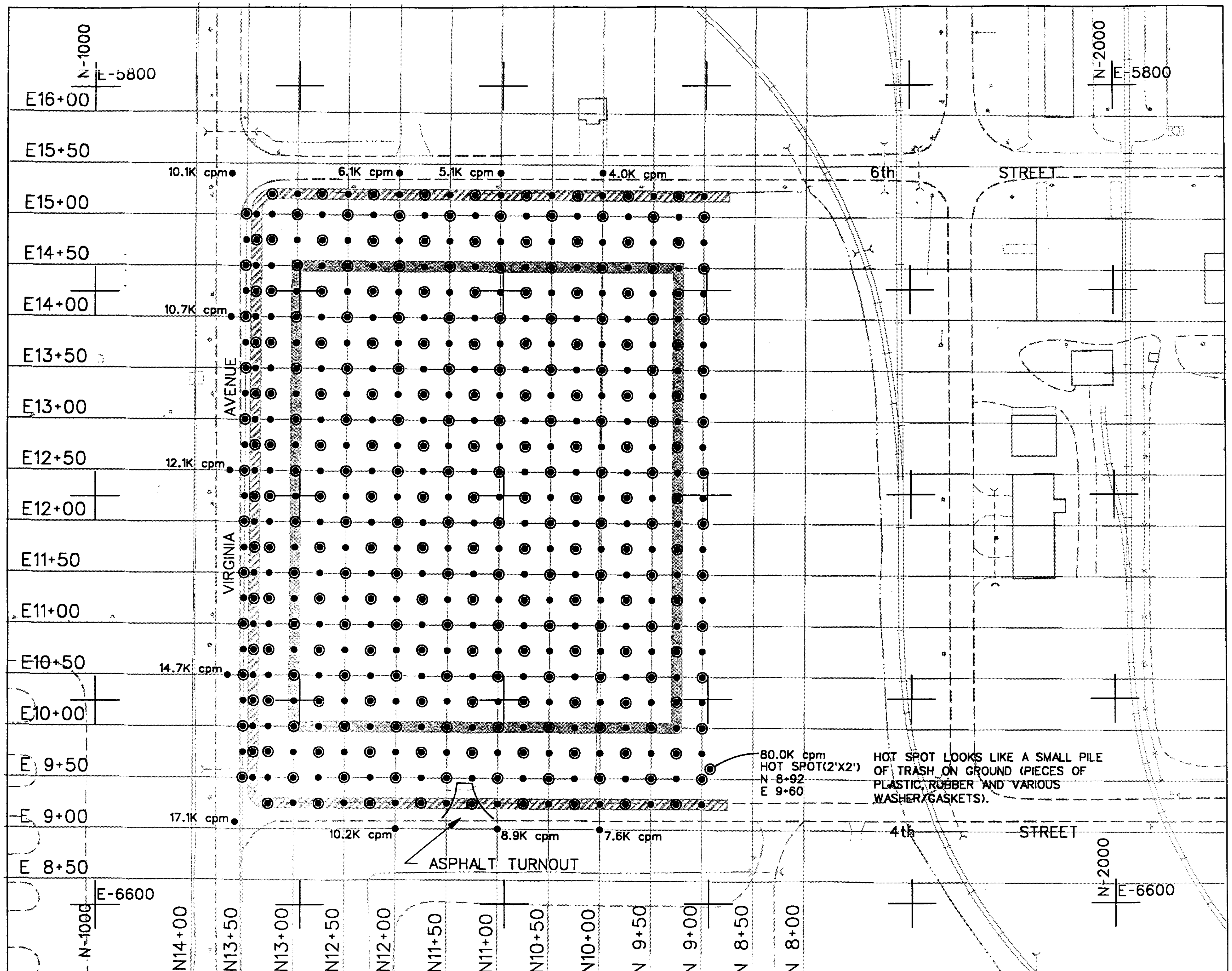
WS 9/9/03
Initials Date
UNCLASSIFIED

Figure 3-2
WMU 1:
RADIATION WALKOVER SURVEY
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

19-Aug-1991 0888tm18.dgn



REVIEWED FOR
CLASSIFICATION
WS 7/9/03
Initials Date
UNCLASSIFIED

LEGEND

C-333	FACILITY NUMBER
O	LOCATION OF SHIELDED/ UNSHIELDED HP-210 READINGS
•	LOCATION OF CONESHIELDED SPA-3 READINGS
	LOCATION OF PERIMETER DITCHES
	APPROX. BOUNDARY OF WASTE MANAGEMENT UNIT(4)

NOTE: U-CYLINDER YARDS LOCATED NORTH & WEST OF WMU.

PLANT GRID

PLANT NORTH
20°
TRUE NORTH

0 50 100 150
SCALE 1"= 150'

Figure 3-3
WMU 4: C-747
RADIATION WALKOVER SURVEY
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

19-Aug-1991 0888tm19.dgn

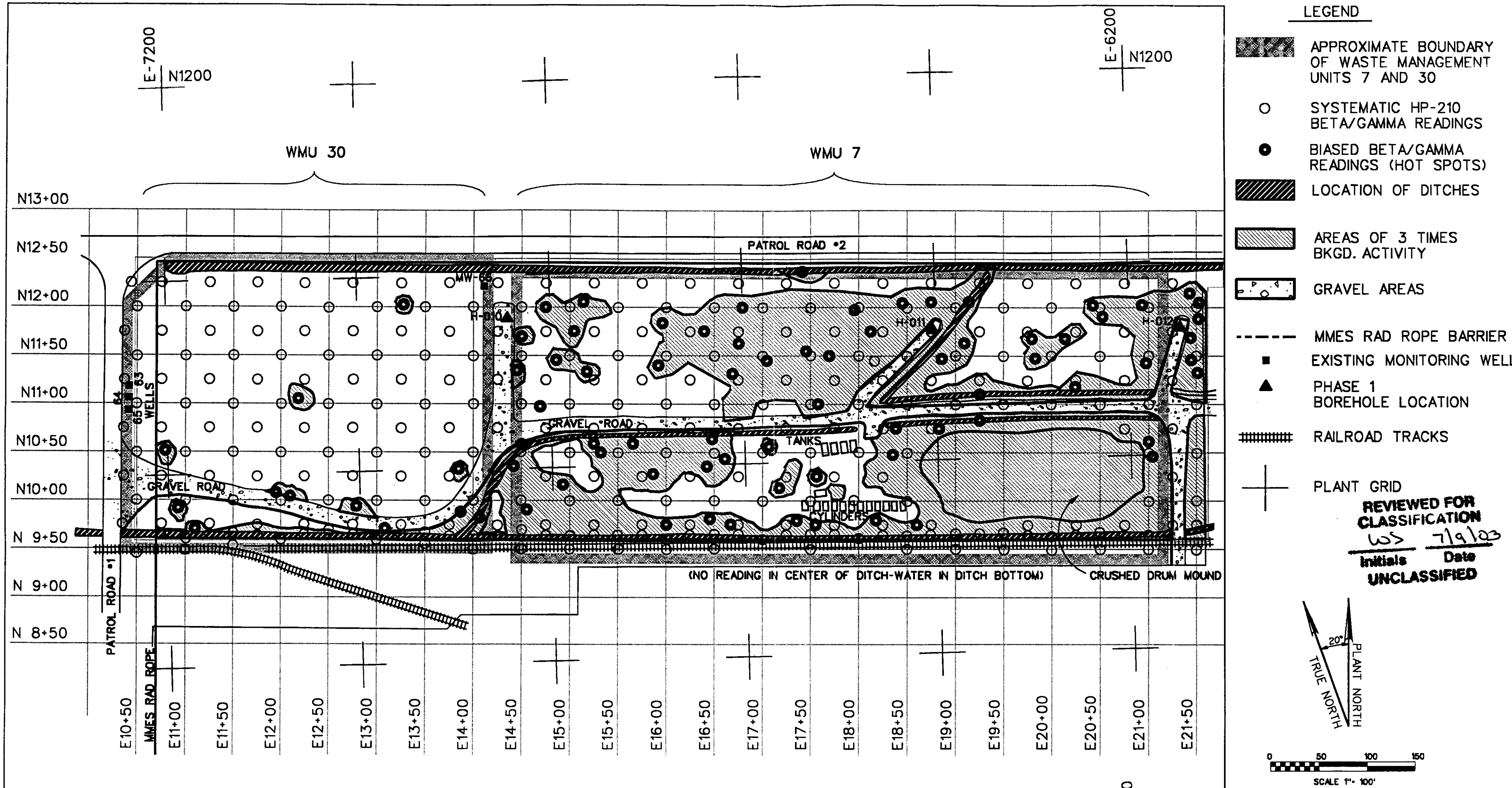
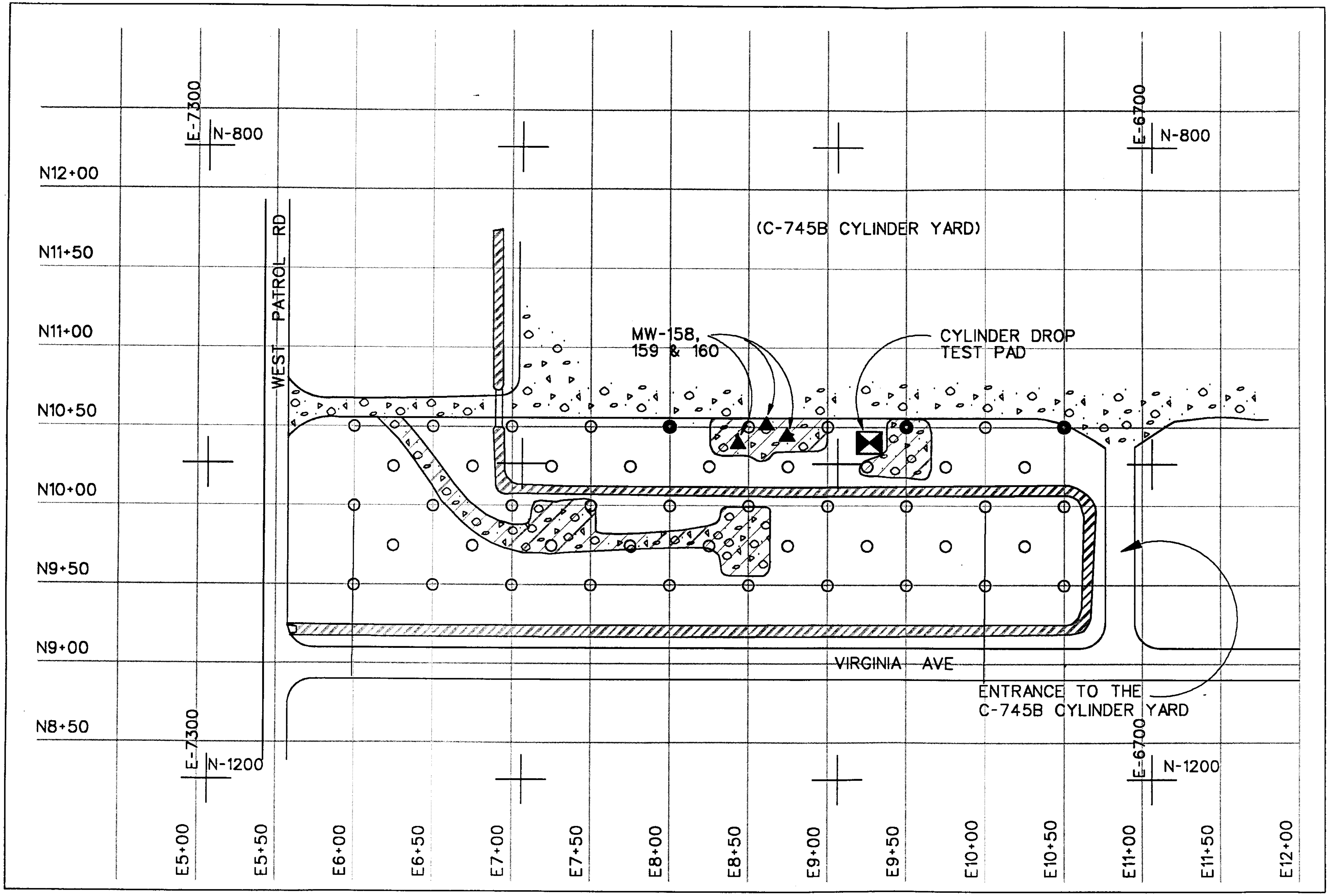


Figure 3-4
WMU 7 AND
WMU 30: RADIATION
WALKOVER SURVEY
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION



LEGEND

- LOCATION OF SYSTEMATIC SHIELDED/UNSHIELDED HP-210 READINGS.
- LOCATION OF BIASED HP-210 READINGS (ELEVATED READINGS)
- LOCATION OF PERIMETER DITCHES
- GRAVEL AREAS
- GRAVEL AREAS PUT IN AFTER SURVEY WAS PERFORMED
- PLANT GRID

REVIEWED FOR CLASSIFICATION
WS 7/9/03
Initials Date
UNCLASSIFIED

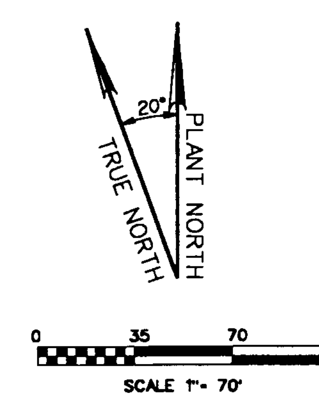
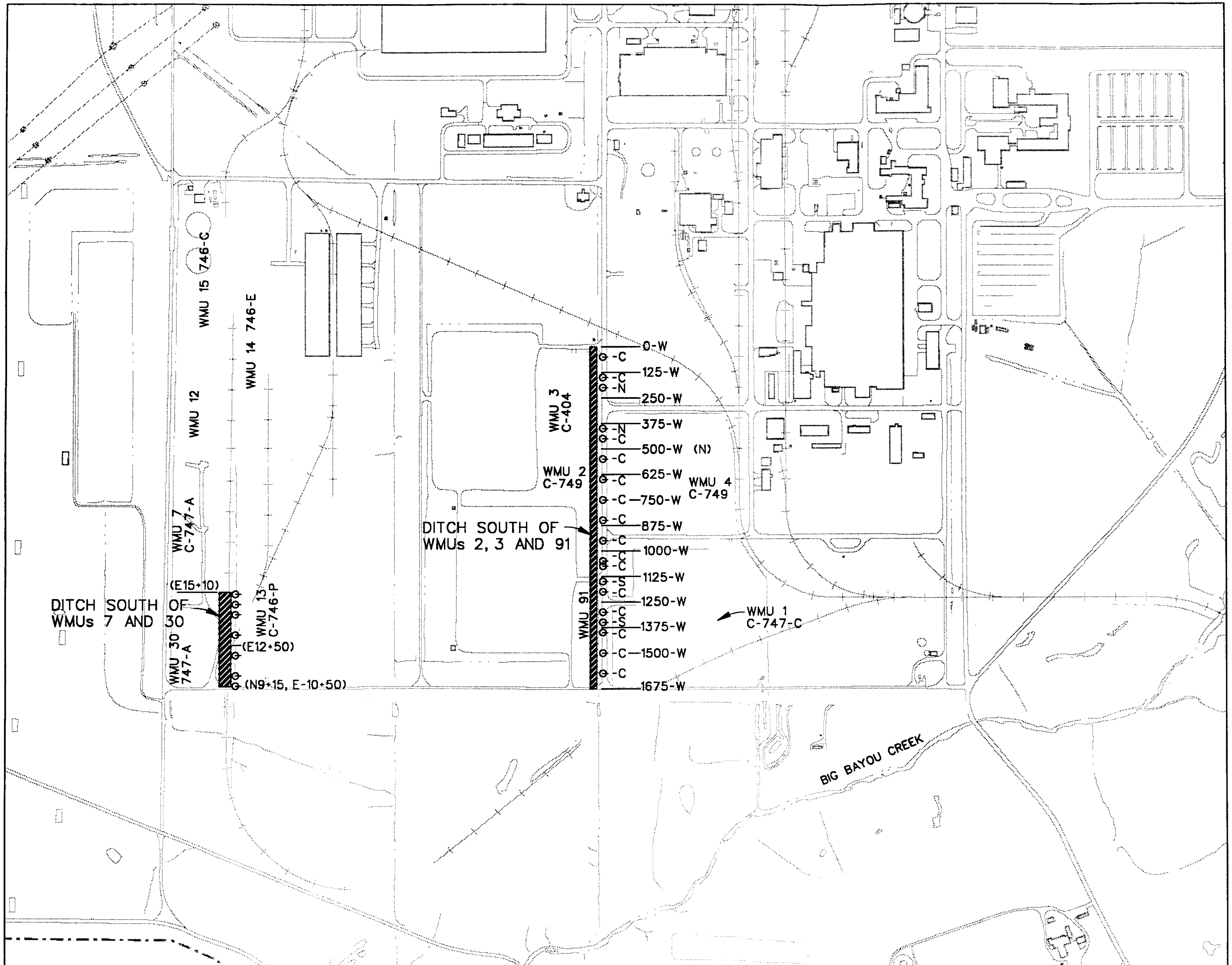


Figure 3-5
WMU 91:
RADIATION WALKOVER SURVEY
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

19-Aug-1991 0888tm21.dgn



LEGEND

(hatched)	LOCATION OF SURVEYED DITCHES
o	HP-210 ELEVATED READINGS
N	NORTH BANK
C	DITCH CENTER
S	SOUTH BANK

REVIEWED FOR CLASSIFICATION
WS 7/9/03
Initials Date
UNCLASSIFIED

PLANT NORTH
20°
TRUE NORTH

0 250 500 750
SCALE 1"= 500'

Figure 3-6
RADIATION WALKOVER SURVEY OF DITCHES
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

19-Aug-1991 0888tm22.dgn

Attachment 3-A
INSTRUMENTATION CALIBRATION

57-014
PADUCAH
C. MORRISSON

TMA
Thermo Analytical Inc.

TMA/Eberline
5635 Jefferson Street NE
Post Office Box 3874
Albuquerque, NM 87190-3874
(505) 345-9931 • FAX (505) 761-5410

SPA-3
CALIBRATION DATA SHEET

SPA-3 SN: EAC # 15 Property of: EAC

Readout Inst.: SAM-100 SN: 00262 Cal. Exp. Date: 3-17-91

Am-241 Source SN: 8640 Activity: 152000 DPM

Date of Calibration: 6-7-90

PLATEAU:

High Voltage	Source (CPM)	Background (CPM)	High Voltage	Source (CPM)	Background (CPM)
600	1.93+03		1000	2.14+04	8.84+03
650	4.16+03		1050	2.17+04	8.90+03
700	6.27+03		1100	2.20+04	8.87+03
750	7.72+03		1150	2.21+04	
800	1.82+04		1200	2.21+04	
850	1.95+04		1250	2.28+04	
900	2.12+04	9.06+03	1300	2.43+04	
950	2.12+04	8.94+03	1350	2.78+04	
			1400	4.29+04	

High Voltage set at: 1000 volts

Ra-226 Cal.:

Ra-226 Source SN: E574 PIC SN: VA023 Cal Exp.Date: 5-14-91

5 Min. Ct.: 6.55+05 CPM: 131000 Intensity: 102.0 uR/hr
5 Min. BKG: 1.02+05 CPM: 20400 Intensity: 18.0 uR/hr

Net CPM: 110600, Net Intensity: 84.0 uR/hr, 1 uR/hr = 1313 CPM

Date of Calibration: 11-20-90 Expiration Date: 5-20-91

Calibrated by: JAMES A. WOODS (Print Name) [signature] (Signature)

Reviewed by: R Haaker Date: 11-20-90

EA4.14
Rev: 1
Date: 25 Jan 88

EA4.14-84

97.841
EAC

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Thermo Analytical Inc.

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Albuquerque, NM 87190-3874
(505) 345-9931

SPA-3
CALIBRATION DATA SHEET

SPA-3 SN: EAC #15 Property of: EAC

Readout Inst.: SPM-200 SN: 00262 Cal. Exp. Date: 9-13-90

Am-241 Source SN: 8603 Activity: 176000 DPM

Date of Calibration: 6-9-89

PLATEAU:

High Voltage	Source (CPM)	Background (CPM)	High Voltage	Source (CPM)	Background (CPM)
600	2.78+03		1000	2.40+04	9.44+03
650	5.69+03		1050	2.41+04	9.45+03
700	8.02+03		1100	2.44+04	9.38+03
750	1.38+04		1150	2.40+04	9.54+03
800	2.13+04		1200	2.46+04	
850	2.28+04		1250	2.53+04	
900	2.37+04		1300	2.83+04	
950	2.38+04	9.22+03	1350	3.60+04	
			1400	—	

High Voltage set at: ~~1000~~ 1050 @ 5-4-90 volts

Ra-226 Cal.:

Ra-226 Source SN: E-554 PIC SN: V4023 Cal Exp.Date: 6-9-90

5 Min. Ct.: 5.94+05 CPM: 118800 Intensity: 102.0 uR/hr
5 Min. BKG: 1.15+05 CPM: 23000 Intensity: 22.0 uR/hr

Net CPM: 95800, Net Intensity: ~~#~~ 80.0 @ 5-4-90 uR/hr, 1 uR/hr = 1198 CPM

Date of Calibration: 5-4-90 Expiration Date: 11-4-90

Calibrated by: JAMES A. WOODS (Print Name) [signature] (Signature)

Reviewed by: Rick Haaker Date: 5/4/90

Rev: 1
Date: 25 Jan 88

EA4.14.04

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TMA/Eberline
795-A Oak Ridge Turnpike
Oak Ridge, TN 37830
(615) 481-0683

57-39
PADUCAH

ASP-1
CALIBRATION DATA SHEET

ASP-1 SN: 1172 # 30 Property of: EAC

MP-1 SN: 710 Cal.Exp.Date: 12-19-90

Electrostatic Voltmeter: 518 SN: 19805 Cal.Exp.Date: 3-15-~~90~~ 91 KM

Regulator Voltage: 5.0 V, 5.00 ± 0.01 volts

ASP-1 Input Sensitivity: 10 mV

Scale	MP-1	Pre-Cal	Post-Cal	Tolerance	High Voltage ESV	IND Pre-Cal	IND Post-Cal
X100	20 CPM	20	20	±2 CPM			
X100	80 CPM	78	78	±2 CPM	600	620	620
X1K	200 CPM	200	210	±10 CPM	1000	1000	1000
X1K	800 CPM	780	790	±10 CPM	1500	1475	1475
X10K	2K CPM	2100	2100	±100 CPM	2000	1950	1950
X10K	8K CPM	8000	8000	±100 CPM	2500	NA	NA
X100K	20K CPM	21K	21K	±1K CPM	H.V. Set:	900	900±50
X100K	80K CPM	90K	90K	89K±1K CPM			

Date of Calibration: 12-10-90 Expiration Date: 6-10-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: Randall H. [illegible] Date: 12-10-90

INSTRUMENT SERVICE LABORATORIES

680 Haines Avenue, N.W.
Albuquerque, New Mexico 87102
(505) 842-1107

601
4/2/90

CERTIFICATE OF CALIBRATION
REPORT NO. 18625

INSTRUMENT SUBMITTED BY:

TMA/EBERLINE
5635 JEFFERSON N.E.
ALBUQUERQUE, NM 87109

Manufacturer EIC-DOE-14501-SC-10157 RAWSON-LUSH ACDC EVM	Model No. 518	Serial No. 19805

RECEIVED	RETURNED
[x] Within Tolerance	[x] Within Tolerance
[ ] Out of Tolerance	[ ] With Limitations
	CALIB ± 1%
	SEE CHART....
[ ] Operational Failure	
[ ] Physical Damage	Calibration Environment
[ ] Other	Temperature 72 F Humidity 40 %
Calibration Date 03-15-90	Recall Date 03-15-91

APPLICABLE NBS TEST REPORT NUMBERS

D C Voltage	243553
A C Voltage	239502, 239605
Resistance	231746, 233681, 236154
Capacitance	231682, 241518
Inductance	230982
Frequency	WWVB Transmission
Temperature	236912
Mass	38129
Length	236940, 241460

Instrument Service Laboratories certifies that the above listed instrument meets or exceeds published manufacturer's specifications and that it has been calibrated using standards whose accuracies are traceable to the National Bureau of Standards. Our "Calibration System Requirements" satisfy MIL-STD-45662.

William L Gardner

Certified By

57-37
PADUCAH

TMA
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(505) 345-9931

SPA-3
CALIBRATION DATA SHEET

SPA-3 SN: #140   Property of: EAC

Readout Inst.: PRS-1   SN: 677   Cal. Exp. Date: 5-17-91

Alpha Source SN: Am-241 52790   Activity: 411000 DPM

Date of Calibration: 5-11-90

PLATEAU:

High Voltage	Source (CPM)	Background (CPM)	High Voltage	Source (CPM)	Background (CPM)
600	3785		1000	46173	6971
650	5063		1050	46593	6643
700	11862		1100	46435	6817
750	37862		1150	46564	
800	42449		1200	46613	
850	45698		1250	47253	
900	46715	6802	1300	47239	
950	46551	6794	1350	47984	
			1400	50991	

High Voltage set at: 1000 volts

Ra-226 Cal.:

Ra-226 Source SN: E-040   PIC SN: 114055   Cal Exp.Date: 8-3-91

5 Min. Ct.: 679849   CPM: 135969.8   Intensity: 84 uR/hr
5 Min. BKG: 133262   CPM: 26652.4   Intensity: 19 uR/hr

Net CPM: 109317.4, Net Intensity: 65 uR/hr, 1 uR/hr = 1682 CPM

Date of Calibration: 12-11-90   Expiration Date: 6-11-91

Calibrated by: KENNETH MURPHY (Print Name)   Kenneth Murphy (Signature)

Reviewed by: Randall H. Bell   Date: 12-11-90

EA4.14
Rev: 1
Date: 25 Jan 88

EA4.14-84

57-014
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SPA-3
CALIBRATION DATA SHEET

SPA-3 SN: EAC #40 Property of: EAC

Readout Inst.: SRM-200 SN: 00262 Cal. Exp. Date: 3-17-91

Am-241 Source SN: 8640 Activity: 152000 DPM

Date of Calibration: 6-7-90

PLATEAU:

High Voltage	Source (CPM)	Background (CPM)	High Voltage	Source (CPM)	Background (CPM)
600	1.29+03 ~~3.66+03~~		1000	2.14+04	8.53+03
650	2.12+03		1050	2.15+04	8.59+03
700	4.70+03		1100	2.14+04	8.67+03
750	6.70+03		1150	2.19+04	8.73+03
800	1.17+04		1200	2.17+04	
850	1.90+04		1250	2.31+04	
900	2.07+04		1300	2.72+04	
950	2.12+04	8.37+03	1350	3.20+04	
			1400	—	

High Voltage set at: 1050 volts

Ra-226 Cal.:

Ra-226 Source SN: E554 PIC SN: V4023 Cal Exp.Date: ~~11-20-90~~ 5-14-91

5 Min. Ct.: 6.30+05 CPM: 126000 Intensity: 101.0 uR/hr
5 Min. BKG: 8.77+04 CPM: 17540 Intensity: 18.0 uR/hr

Net CPM: 108460, Net Intensity: 83.0 uR/hr, 1 uR/hr = 1307 CPM

Date of Calibration: 11-20-90 Expiration Date: 5-20-91

Calibrated by: JAMES A. WOODS (signature)
(Print Name) (Signature)

Reviewed by: R Haaker Date: 11-20-90

TMA
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(505) 345-9931

97-94
EAC
PADUCAH
C MORRISON

HP-270
CALIBRATION DATA SHEET

HP-270 SN: CC-81 #1 Property of: EAC

Readout Inst.: PRS-1 SN: 801 Cal. Exp. Date: 1-19-91

High Voltage set at 900 volts

PIC SN: V4023 Cal Exp. Date: 5-14-91

Gamma Source SN: RA-226 E-554

5 Min. Ct.: 829 CPM: 165.8 Intensity: .103 mR/hr

5 Min. BKG: 171 CPM: 34.2 Intensity: .019 mR/hr

Net CPM = 131.6 Net Intensity: .084 mR/hr

$$1 \text{ mR/hr} = \frac{\text{Net CPM}}{\text{Net Intensity}} = 1567 \text{ CPM}$$

Date of Calibration: 8-13-90 Expiration Date: 2-13-91

Calibrated by: JAMES A. WOODS (Print Name) [signature] (Signature)

Reviewed by: Rick Hacker Date: 8-13-90

EA4.13
Rev: 1
Date: 25 Jan 88

EA4.13-79

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MS-17
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HP-210
CALIBRATION DATA SHEET

HP-210 SN: 105 Property of: EAC

Readout Inst.: MS-2 SN: 1175 Cal. Exp. Date: 9-8-90

High Voltage set at 900 volts

Beta Source SN: TC-99 1848/90 Activity: 7840 DPM mRad/hr: NA.

Date of Calibration: 5-15-90

Beta Efficiency:

Geometry: SH-4 (with planchet)

5 Min. Ct: 3808 CPM: 761.6

5 Min. BKG: 163 CPM: 32.6

Net CPM: 729.0

$$\text{Efficiency} = \frac{\text{Net CPM}}{\text{DPM}} \times 100 = 9.3\ \%$$

1 mRad/hr = NA. CPM

Date of Calibration: 8-6-90 Expiration Date: 2-6-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: J.A.B. Date: 8/9/90

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HP-210
CALIBRATION DATA SHEET

HP-210 SN: 102 Property of: EAC

Readout Inst.: MS-2 SN: 1175 Cal. Exp. Date: 9-8-90

High Voltage set at 900 volts

Beta Source SN: TC-99 1848/90 Activity: 7840 DPM mRad/hr: N.A.

Date of Calibration: 5-15-90

Beta Efficiency:

Geometry: SH-4 (with planchet)

5 Min. Ct: 3959 CPM: 791.8

5 Min. BKG: 132 CPM: 26.4

Net CPM: 765.4

$$\text{Efficiency} = \frac{\text{Net CPM}}{\text{DPM}} \times 100 = 9.8\ \%$$

1 mRad/hr = NA CPM

Date of Calibration: 8-6-90 Expiration Date: 2-6-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: J.A.B. Date: 8/9/90

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HP-210
CALIBRATION DATA SHEET

HP-210 SN: 101 Property of: EAC

Readout Inst.: MS-2 SN: 1175 Cal. Exp. Date: 9-8-90

High Voltage set at 900 volts

Tc 99
Beta Source SN: 1848/90 Activity: 7840 DPM mRad/hr: N.A.

Date of Calibration: 5-15-90

Beta Efficiency:

Geometry: SH-4 (with planchet)

5 Min. Ct: 3962 CPM: 792.4

5 Min. BKG: 156 CPM: 31.2

Net CPM: 761.2

$$\text{Efficiency} = \frac{\text{Net CPM}}{\text{DPM}} \times 100 = \underline{9.7}\ \%$$

1 mRad/hr = NA CPM

Date of Calibration: 8-6-90 Expiration Date: 2-6-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: J.G.B. Date: 8/9/90

EA4.11
Rev: 1
Date: 25 Jan 88

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57-39
PADUCAH

ESP-1
CALIBRATION DATA SHEET

ESP-1 SN: 923 Property of: EAC

Location: PADUCAH

High Voltage Check:

Electrostatic Voltmeter SN: 19805 Cal. Exp. Date: 3-15-91

ESV	Pre-Cal	Post-Cal	Tolerance
600V	610	610	600±30V
1000V	1010	1010	1000±50V
1400V	1350	1350	1400±70V

H.V. set at: 900 volts

Input Sensitivity Check:

MP-1 SN: 710 Cal. Exp. Date: 12-17-90

	Pre-Cal	Post-Cal	
>12mV	—	12.0	12mV±0.5mV
<12mV	—		

Scaler

MP-1	ESP-1	Tolerance
1000 CPM	999 CPM	1000±5 CPM
10000 CPM	9999 CPM	10000±50 CPM
100K CPM	100K CPM	100K±500 CPM

Date of Calibration: 12-10-90 Expiration Date: 6-10-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: Randall H. Sells Date: 12-10-90

EA4.26
Rev: 1
Date: 17 April 89

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Paducah
75-39

ESP-~~1~~ 2 / 1km
CALIBRATION DATA SHEET

ESP-1 SN: 2014 Property of: EAC

Location: Paducah

High Voltage Check:

Electrostatic Voltmeter SN: 19805 Cal. Exp. Date: 3-15-91

ESV	Pre-Cal	Post-Cal	Tolerance
600V	630	610	600±30V
1000V	950	995	1000±50V
1400V	1360	1410	1400±70V

H.V. set at: 900 volts

Input Sensitivity Check:

MP-1 SN: 507 Cal. Exp. Date: 4-9-91

	Pre-Cal	Post-Cal	
>12mV		12	12mV±0.5mV
<12mV	14		

Scaler

MP-1	ESP-1	Tolerance
1000 CPM	1000 CPM	1000±5 CPM
10000 CPM	10000 CPM	10000±50 CPM
100K CPM	99900 CPM	100K±500 CPM

Date of Calibration: 1-28-91 Expiration Date: 7-28-91

Calibrated by: Randall H. Selb (Print Name) Randall H. Selb (Signature)

Reviewed by: Kenneth Murphy Date: 1-29-91

EA4.26
Rev: 1
Date: 17 April 89

EA4.26-160

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ESP-1
CALIBRATION DATA SHEET

ESP-1 SN: 923 Property of: EAC

Location: PADUCAH

High Voltage Check:

Electrostatic Voltmeter SN: 19805 Cal. Exp. Date: 3-15-91

ESV	Pre-Cal	Post-Cal	Tolerance
600V	610	610	600±30V
1000V	1010	1010	1000±50V
1400V	1350	1350	1400±70V

H.V. set at: 900 volts

Input Sensitivity Check:

MP-1 SN: 710 Cal. Exp. Date: 12-17-90

	Pre-Cal	Post-Cal	
>12mV	—	12.0	12mV±0.5mV
<12mV	—		

Scaler

MP-1	ESP-1	Tolerance
1000 CPM	999 CPM	1000±5 CPM
10000 CPM	9999 CPM	10000±50 CPM
100K CPM	100K CPM	100K±500 CPM

Date of Calibration: 12-10-90 Expiration Date: 6-10-91

Calibrated by: KENNETH MURPHY (Print Name) Kenneth Murphy (Signature)

Reviewed by: Randall H. Sells Date: 12-10-90

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75-39

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PRS-1
CALIBRATION DATA SHEET

PRS-1 SN: 592 Property of: EAC

Battery OK/ERROR Legend Threshold: 5.6 volts

Electrostatic Voltmeter: 518 SN: 19805 Cal.Exp.Date: 3-15-91

High Voltage Display:

ESV	Pre-Cal	Post-Cal	Tolerance
600 V	612	603	600±12 V
1000 V	1003	1003	1000±20 V
1400 V	1398	1398	1400±28 V

Input Sensitivity:

(threshold at 0100) Pre-Cal: 10 mV, Post-Cal 10 10±.5 mV

MP-1 SN: 507 Cal.Exp.Date: 4-9-91

Rate:	MP-1	PRS-1	Display(CPM)	Tolerance(CPM)
	400 CPM	A	400	400±4
	4K CPM	B	4008	4K±40
	40K CPM	C	39736	40K±400
	400K CPM	D	397360	400K±4K
Scaler:	100K CPM	0.5	50K	50K±50
	100K CPM	1.0	100K	100K±100
	100K CPM	2.0	200K	200K±200
	100K CPM	5.0	500012	500K±500

Functional Check: Manual ✓ Stop ✓ Speaker ✓ Headphones ✓ Light ✓

Date of Calibration: 1-28-91 Expiration Date: 7-28-91

Calibrated by: Randall H. Selb (Print Name) Randall H. Selb (Signature)

Reviewed by: Kenneth Murphy Date: 1-29-91

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PRS-1
CALIBRATION DATA SHEET

PRS-1 SN: 275 Property of: Paudacah EAC

Battery OK/ERROR Legend Threshold: 5.65 volts

Electrostatic Voltmeter: 518 SN: 19805 Cal.Exp.Date: 3-15-91

High Voltage Display:

ESV	Pre-Cal	Post-Cal	Tolerance
600 V	611	611	600±12 V
1000 V	1005	1005	1000±20 V
1400 V	1403	1403	1400±28 V

Input Sensitivity:

(threshold at 0100) Pre-Cal: 10 mV, Post-Cal 10 10±.5 mV

MP-1 SN: 710 Cal.Exp.Date: 12-14-90

Rate:	MP-1	PRS-1	Display(CPM)	Tolerance(CPM)
	400 CPM	A	400	400±4
	4K CPM	B	4008	4K±40
	40K CPM	C	39736	40K±400
	400K CPM	D	397,360	400K±4K
Scaler:	100K CPM	0.5	50,000	50K±50
	100K CPM	1.0	100 K	100K±100
	100K CPM	2.0	200 K	200K±200
	100K CPM	5.0	500 K	500K±500

Functional Check: Manual ✓ Stop ✓ Speaker ✓ Headphones ✓ Light ✓

Date of Calibration: 9-13-90 Expiration Date: 3-13-91

Calibrated by: Randall H. Selk (Print Name) Randall H. Selk (Signature)

Reviewed by: Kenneth Murphy Date: 9-13-90

EA4.2
Rev: 0
Date: 10 Dec 85

Env
8/21/90

Reuter-Stokes

CALIBRATION CERTIFICATE

Reuter-Stokes certifies that the Environmental Radiation Monitor, identified below, has been calibrated for output using the shadow shield technique*, and calibrated with radiation sources traceable to the National Institute of Standards and Technology.

Model Number RSS-111-500uR

Serial Number V-4055

Calibration Date 8/3/90

Authorized Signature

* See Operating Manual for details on technique.

* The calibration was performed to original manufacturer's tolerances.

Attachment 3-B
GAMMA WALKOVER SURVEY MEASUREMENTS

ATTACHMENT 3-B
GAMMA WALKOVER SURVEY

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #1	N10+00, E9+50	30-790K	BEGINNING OF DITCH RUNNING EAST TO WEST
			HOT SPOT @ N10+45, E10+00: 180K cpm
			HOT SPOT @ N10+45, E9+85: 790K cpm
			HOT SPOT @ N10+33, E9+86: 220K cpm
			GRASSY / (NO SURVEY WEST OF R/R TRACKS)
	N9+50, E9+50	28-46K	GRASSY / (NO SURVEY WEST OF R/R TRACKS)
	N10+00, E10+00	32-600K	N.-S. DITCH: 100-200K cpm
			E.-W. DITCH: 100-600K cpm
			FIELD: 32-60K cpm
			GRASSY, GRAVEL NORTH OF DITCH
	N9+50, E10+00	32-96K	GRASSY IN FIELD 32-50K cpm
			DITCH 50-96K cpm
	N9+00, E10+00	28-66K	FIELD 28-35K cpm
			DITCH 48-66K cpm
			GRASSY / (NO SURVEY WEST OF R/R TRACKS)
	N8+50, E10+00	20-30K	GRASSY / (NO SURVEY WEST OF R/R TRACKS)
	N8+00, E10+00	18-25K	GRASSY / (NO SURVEY WEST OF R/R TRACKS)
	N10+00, E10+50	35-160K	ELEVATED IN DITCH (GRAVEL N. OF DITCH)
			HOT SPOT @ N10+44, E10+70: 160K cpm
			GRASS SOUTH OF DITCH
	N9+50, E10+50	35-45K	GRASS THROUGHOUT GRID BLOCK
	N9+00, E10+50	30-65K	ELEVATED IN DITCH / GRASS, MUD
	N8+50, E10+50	25-50K	ELEVATED IN DITCH / GRASS, GRAVEL, MUD
	N8+00, E10+50	16-28K	ELEVATED IN DITCH
			GRAVEL, GRASS, MUD, R/R TRACKS
	N10+00, E11+00	50-60K	GRAVEL NORTH OF DITCH
	" "	80-90K	DITCH - GRASS, MUD
	" "	40-50K	GRASS THROUGHOUT REMAINDER OF GRID BLOCK
			GRASS, MUD
	N9+50, E11+00	30-50K	GRASS THROUGHOUT GRID BLOCK
	N9+00, E11+00	30-50K	GRASS THROUGHOUT GRID BLOCK/SPOT 50K cpm
	N8+50, E11+00	23-33K	GRASS THROUGHOUT GRID BLOCK DITCH @ SOUTH
	N8+00, E11+00	22-26K	DITCH @ NORTH SIDE OF BLOCK
			GRASS THROUGHOUT GRID BLOCK
	N10+00, E11+50	45-55K	GRAVEL NORTH OF DITCH (CYLINDER YARD)
	" "	80-150K	GRASS SOUTH OF DITCH
	" "	45-55K	SEVERAL HOT SPOTS IN BOTTOM OF DITCH-AS FOLLOWS:
			N10+30, E11+60 (100Kcpm), N10+35, E11+70 (100Kcpm)
			N10+35, E11+75 (100Kcpm), N10+35, E11+77 (100Kcpm)
			N10+35, E11+90 (100Kcpm), N10+35, E11+98 (150Kcpm)
			AND N10+34, E12+00 (130Kcpm)
	N9+50, E11+50	30-60K	GRASS THROUGHOUT GRID BLOCK
	N9+00, E11+50	30-65K	GRASS THROUGHOUT GRID BLOCK
	N8+50, E11+50	25-30K	GRASS THROUGHOUT GRID BLOCK
	N8+00, E11+50	20-25K	SEWER LID / GRASS THROUGHOUT GRID BLOCK
	N10+00, E12+00	30K-4M cpm	HOT SPOTS:N10+34, E12+23:130K-800K
			N10+36, E12+25: 1.1 MILLION cpm
			N10+50, E12+25: 400K cpm
			N10+36, E10+45: 350K - 450K cpm
			N10+34, E12+47: 450K cpm
			N10+48, E12+47: 4 MILLION cpm (OVERRANGE)
			GRASSY, GRAVEL NORTH OF DITCH
	N9+50, E12+00	28-231K	HOT SPOT @ N9+79, E12+47: 231K cpm
			FIELD: 28-41K cpm
			GRASSY THROUGHOUT GRID BLOCK
	N9+00, E12+00	25-36K	GRASSY THROUGHOUT GRID BLOCK
	N8+50, E12+00	21-31K	GRASSY THROUGHOUT GRID BLOCK

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #1	N8+00, E12+00	17-26K	GRASSY - HILLSIDE (DITCH 5' SOUTH OF GRID)
	N10+00, E12+50	27-650K	HOT SPOTS: N10+34, E12+50; 270-400K cpm
			N10+34, E12+50:400K cpm N10+42, E12+65: 178K cpm
			N10+48, E12+69: 340K cpm
			N10+51, E12+68: 650K cpm
			FIELD: 27-60K cpm
			GRASSY, GRAVEL NORTH OF DITCH
	N9+50, E12+50	26-102K	N9+56, E12+70: 102K cpm
			FIELD: 26-57K cpm
			GRASS THROUGHOUT GRID BLOCK
	N9+00, E12+50	20-31K	GRAVEL SPOT/GRASSY THROUGHOUT GRID BLOCK
	N8+50, E12+50	17-26K	GRASSY THROUGHOUT GRID BLOCK
	N8+00, E12+50	17-24K	GRASSY - HILLSIDE (DITCH 5' SOUTH OF GRID)
	N10+00, E13+00	30-441K	HOT SPOT @ N10+50, E13+38: 441K cpm
			FIELD: 30-40K cpm
			GRASSY, GRAVEL NORTH OF DITCH
	N9+50, E13+00	18-203K	HOT SPOT @ N9+64, E13+09: 124K cpm
			HOT SPOT @ N9+64, E13+14: 203K cpm
			FIELD: 18-37K cpm
			H110 - PROPOSED BOREHOLE LOCATION / GRASSY
	N9+00, E13+00	18-27K	GRASSY, OLD GRAVEL ROAD
	N8+50, E13+00	17-25K	GRASSY, OLD GRAVEL ROAD
	N8+00, E13+00	15-25K	GRASSY - HILLSIDE WITH DITCH ~5' SOUTH OF HILL
	N10+00, E13+50	31-67K	GRASSY, GRAVEL NORTH OF DITCH
	N9+50, E13+50	20-37K	GRASSY, OLD GRAVEL ROAD
	N9+00, E13+50	18-27K	GRASSY, OLD GRAVEL ROAD
	N8+50, E13+50	17-26K	GRASSY - HILLSIDE
	N8+00, E13+50	15-22K	GRASSY - HILLSIDE - R/R TRACKS - DITCH
	N10+00, E14+00	27-121K	HOT SPOT @ N10+51, E14+14: 121K cpm
			FIELD / GRASSY - GRAVEL NORTH OF DITCH: 27-39K cpm
	N9+50, E14+00	21-30K	GRASSY - OLD GRAVEL ROAD
	N9+00, E14+00	21-40K	GRASSY - OLD GRAVEL ROAD
	N8+50, E14+00	16-24K	GRASSY - HILLSIDE - DITCH
	N8+00, E14+00	16-20K	NO SURVEY SOUTH OF R/R TRACKS
			GRASSY - HILLSIDE - DITCH - R/R TRACKS
	N10+00, E14+50	25-35K	GRAVEL NORTH OF DITCH / GRASS SOUTH OF DITCH
	N9+50, E14+50	25-30K	GRASS
	" "	20K	GRAVEL ROAD RUNS THROUGH GRID
	" "	20-25K	GRASS
	N9+00, E14+50	20-35K	GRASS THROUGHOUT GRID BLOCK
	N8+50, E14+50	16-23K	GRASS, GRAVEL AROUND R/R TRACKS
	N10+00, E15+00	25-175K	FROM WEST SIDE OF GRID TO 4TH ST. IS ~ 39'.
			HOT SPOT @ N10+25, E15+03: 175K cpm
			GRASS, GRAVEL, PAVEMENT
	N9+50, E15+00	15-40K	GRASS, GRAVEL, PAVEMENT
	N9+00, E15+00	15-20K	GRASS, PAVEMENT
	N8+50, E15+00	15-20K	GRASS, PAVEMENT, R/R TRACKS

* (gross cpm) - gross counts per minute, includes background

ATTACHMENT 3-B
GAMMA WALKOVER SURVEY

AREA JRVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N13+25, E9+37	16K	QUALITY CONTROL 16.4K cpm
	N13+00, E9+37	18K	
	N12+75, E9+37	17.8K	
	N12+50, E9+37	19.9K	
	N12+25, E9+37	20.3K	
	N12+00, E9+37	22.6K	
	N11+75, E9+37	18.3K	
	N11+50, E9+37	12.1K	
	N11+25, E9+37	12.9K	
	N11+00, E9+37	17.5K	QUALITY CONTROL 17.6K cpm
	N10+75, E9+37	17.7K	
	N10+50, E9+37	17.6K	
	N10+25, E9+37	18.3K	
	N10+00, E9+37	17.6K	
	N9+75, E9+37	12.8K	
	N9+50, E9+37	11.4K	
	N9+25, E9+37	11.7K	
	N9+00, E9+37	11.1K	
	N13+50, E9+50	15.9K	BOTTOM OF DITCH 20.3K cpm
	N13+25, E9+50	20.6K	
	N13+00, E9+50	17.6K	
	N12+75, E9+50	15.9K	
	N12+50, E9+50	15.5K	
	N12+25, E9+50	14.3K	
	N12+00, E9+50	13.6K	
	N11+75, E9+50	13.1K	QUALITY CONTROL 13.2K cpm
	N11+50, E9+50	13.5K	
	N11+25, E9+50	11.7K	
	N11+00, E9+50	13.2K	
	N10+75, E9+50	12.6K	
	N10+50, E9+50	12.6K	
	N10+25, E9+25	12.8K	
	N10+00, E9+50	20.1K	
	N9+75, E9+50	18.8K	
	N9+50, E9+50	14.1K	
	N9+25, E9+50	11.3K	
	N9+00, E9+50	11.8K	HOT SPOT N8+92, E9+60: 80K cpm
			QUALITY CONTROL 11.7K cpm
	N13+50, E9+75	17.1K	BOTTOM OF DITCH 16.9K cpm
	N13+25, E9+75	18.9K	
	N13+00, E9+75	17.2K	
	N12+75, E9+75	16.2K	
	N12+50, E9+75	14.7K	
	N12+25, E9+75	14.3K	
	N12+00, E9+75	13.7K	
	N11+75, E9+75	12.9K	
	N11+50, E9+75	12.3K	
	N11+25, E9+75	11.8K	
	N11+00, E9+75	11.7K	
	N10+75, E9+75	10.7K	QUALITY CONTROL 10.9K cpm
	N10+50, E9+75	11.0K	
	N10+25, E9+75	10.7K	
	N10+00, E9+75	11.0K	
	N9+75, E9+75	10.3K	
	N9+25, E9+75	20.2K	
	N9+50, E9+75	31.2K	READING BIASED TO N9+49 DUE TO INCREASED COUNTS
	N9+00, E9+75	10.0K	
	N13+50, E10+00	16.8K	BOTTOM OF DITCH 21.2K cpm
	N13+25, E10+00	19.7K	
	N13+00, E10+00	16.4K	
	N12+75, E10+00	15.7K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N12+50, E10+00	14.7K	
	N12+25, E10+00	13.8K	
	N12+00, E10+00	12.7K	QUALITY CONTROL 12.6K cpm
	N11+75, E10+00	12.4K	
	N11+50, E10+00	12.1K	
	N11+25, E10+00	11.8K	
	N11+00, E10+00	11.1K	
	N10+75, E10+00	10.8K	
	N10+50, E10+00	10.4K	
	N10+25, E10+00	10.3K	
	N10+00, E10+00	10.3K	
	N9+75, E10+00	9.8K	
	N9+50, E10+00	12.0K	
	N9+25, E10+00	22.1K	QUALITY CONTROL 21.8K cpm
	N9+00, E10+00	8.3K	
	N13+50, E10+25	18.4K	BOTTOM OF DITCH 18.8K cpm
	N13+25, E10+25	20.5K	
	N13+00, E10+25	17.8K	
	N12+75, E10+25	16.9K	
	N12+50, E10+25	15.9K	
	N12+25, E10+25	15.2K	
	N12+00, E10+25	14.3K	
	N11+75, E10+25	13.6K	
	N11+50, E10+25	13.1K	
	N11+25, E10+25	12.5K	
	N11+00, E10+25	12.0K	QUALITY CONTROL 11.7K cpm
	N10+75, E10+25	11.4K	
	N10+50, E10+25	11.6K	
	N10+25, E10+25	10.9K	
	N10+00, E10+25	10.9K	
	N9+75, E10+25	10.3K	
	N9+50, E10+25	14.5K	
	N9+25, E10+25	9.4K	
	N9+00, E10+25	8.6K	
	N13+50, E10+50	18.0K	BOTTOM OF DITCH 22.3K cpm
	N13+25, E10+50	19.3K	
	N13+00, E10+50	17.5K	
	N12+75, E10+50	16.4K	
	N12+50, E10+50	15.5K	
	N12+25, E10+50	14.7K	
	N12+00, E10+50	14.2K	
	N11+75, E10+50	13.5K	
	N11+50, E10+50	13.0K	QUALITY CONTROL 12.7K cpm
	N11+25, E10+50	12.4K	
	N11+00, E10+50	11.8K	
	N10+75, E10+50	11.6K	
	N10+50, E10+50	10.8K	
	N10+25, E10+50	10.6K	
	N10+00, E10+50	10.7K	
	N9+75, E10+50	10.0K	
	N9+50, E10+50	14.9K	
	N9+25, E10+50	8.6K	
	N9+00, E10+50	8.1K	QUALITY CONTROL 8.11K cpm
	N13+50, E10+75	17.5K	BOTTOM OF DITCH 21.2K cpm
	N13+25, E10+75	19.7K	QUALITY CONTROL 19.2K cpm
	N13+00, N10+75	17.4K	
	N12+75, E10+75	16.4K	
	N12+50, E10+75	15.3K	
	N12+25, E10+75	14.8K	
	N12+00, E10+75	14.2K	
	N11+75, E10+75	13.4K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+50, E10+75	13.0K	
	N11+25, E10+75	12.3K	QUALITY CONTROL 12.2K cpm
	N11+00, E10+75	11.9K	
	N10+75, E10+75	11.5K	
	N10+50, E10+75	11.1K	
	N10+25, E10+75	10.8K	
	N10+00, E10+75	10.6K	
	N9+75, E10+75	10.0K	
	N9+50, E10+75	13.1K	
	N9+25, E10+75	8.2K	
	N9+00, E10+75	7.5K	
	N13+50, E11+00	17.9K	BOTTOM OF DITCH 20.3K cpm
	N13+25, E11+00	19.1K	
	N13+00, E11+00	17.2K	
	N12+75, E11+00	15.8K	
	N12+50, E11+00	14.9K	
	N12+25, E11+00	14.5K	
	N12+00, E11+00	13.7K	
	N11+75, E11+00	13.4K	
	N11+50, E11+00	12.6K	QUALITY CONTROL 12.6K cpm
	N11+25, E11+00	12.2K	
	N11+00, E11+00	11.6K	
	N10+75, E11+00	11.3K	
	N10+50, E11+00	10.4K	
	N10+25, E11+00	10.6K	
	N10+00, E11+00	10.0K	
	N9+75, E11+00	9.9K	
	N9+50, E11+00	17.3K	
	N9+25, E11+00	8.2K	QUALITY CONTROL 8.34K cpm
	N9+00, E11+00	7.4K	
	N13+50, E11+25	17.9K	BOTTOM OF DITCH 23.3K cpm
	N13+25, E11+25	19.1K	-
	N13+00, E11+25	17.0K	QUALITY CONTROL 16.8K cpm
	N12+75, E11+25	15.7K	
	N12+50, E11+25	15.1K	
	N12+25, E11+25	14.3K	
	N12+00, E11+25	13.7K	
	N11+75, E11+25	12.9K	
	N11+50, E11+25	12.4K	
	N11+25, E11+25	12.1K	
	N11+00, E11+25	11.4K	
	N10+75, E11+25	11.2K	QUALITY CONTROL 11.4K cpm
	N10+50, E11+25	10.8K	
	N10+25, E11+25	10.5K	
	N10+00, E11+25	10.2K	READING BIASED DUE TO INCREASED COUNT RATE @ N9+56, 28.3K cpm
	N9+75, E11+25	9.8K	
	N9+50, E11+25	12.0K	
	N9+25, E11+25	7.5K	
	N9+00, E11+25	8.1K	
	N13+50, E11+50	17.4K	BOTTOM OF DITCH 23.0K cpm
	N13+25, E11+50	18.1K	
	N13+00, E11+50	16.2K	
	N12+75, E11+50	15.0K	
	N12+50, E11+50	14.0K	
	N12+25, E11+50	13.5K	
	N12+00, E11+50	13.0K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+75, E11+50	12.2K	
	N11+50, E11+50	11.9K	
	N11+25, E11+50	11.5K	
	N11+00, E11+25	11.2K	
	N10+75, E11+50	10.6K	
	N10+50, E11+50	10.2K	QUALITY CONTROL 10.4K cpm
	N10+25, E11+50	9.9K	
	N10+00, E11+50	9.6K	
	N9+75, E11+50	9.4K	
	N9+50, E11+50	10.8K	
	N9+25, E11+50	7.50K	
	N9+00, E11+50	8.1K	
	N13+50, E11+75	16.5K	BOTTOM OF DITCH 18.5K cpm
	N13+25, E11+75	17.2K	
	N13+00, E11+75	16.0K	
	N12+75, E11+75	15.1K	
	N12+50, E11+75	14.3K	
	N12+25, E11+75	13.5K	QUALITY CONTROL 13.2K cpm
	N12+00, E11+75	12.7K	
	N11+75, E11+75	12.4K	
	N11+50, E11+75	11.7K	
	N11+25, E11+75	11.6K	
	N11+00, E11+75	11.2K	
	N10+75, E11+75	10.7K	
	N10+50, E11+75	10.4K	
	N10+25, E11+75	9.9K	
	N10+00, E11+75	9.5K	
	N9+75, E11+75	9.0K	QUALITY CONTROL 9.29K cpm
	N9+50, E11+75	10.2K	
	N9+25, E11+75	8.5K	
	N9+00, E11+75	8.6K	
	N13+50, E12+00	16.3K	BOTTOM OF DITCH 19.4K cpm
	N13+25, E12+00	17.2K	
	N13+00, E12+00	15.4K	
	N12+75, E12+00	14.5K	
	N12+50, E12+00	13.6K	QUALITY CONTROL 13.8K cpm
	N12+25, E12+00	13.2K	
	N12+00, E12+00	12.5K	
	N11+75, E12+00	12.1K	
	N11+50, E12+00	11.5K	
	N11+25, E12+00	10.9K	
	N11+00, E12+00	10.6K	
	N10+75, E12+00	10.5K	
	N10+50, E12+00	9.7K	
	N10+25, E12+00	10.1K	
	N10+00, E12+00	9.3K	QUALITY CONTROL 9.50K cpm
	N9+75, E12+00	9.2K	
	N9+50, E12+00	13.2K	READING BIASED TO N9+53 DUE TO INCREASED
	N9+25, E12+00	8.0K	COUNT RATE
	N9+00, E12+00	8.6K	
	N13+50, E12+25	16.0K	BOTTOM OF DITCH 19.1K cpm
	N13+25, E12+25	17.1K	
	N13+00, E12+25	15.5K	
	N12+75, E12+25	14.6K	QUALITY CONTROL 14.4K cpm
	N12+50, E12+25	13.9K	
	N12+25, E12+25	13.5K	
	N12+00, E12+25	12.6K	
	N11+75, E12+25	12.1K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+50, E12+25	11.7K	
	N11+25, E12+25	11.3K	
	N11+00, E12+25	10.8K	
	N10+75, E12+25	10.4K	
	N10+50, E12+25	9.8K	QUALITY CONTROL 9.93K cpm
	N10+25, E12+25	9.7K	
	N10+00, E12+25	9.6K	
	N9+75, E12+25	9.3K	
	N9+50, E12+25	9.2K	
	N9+25, E12+25	9.8K	
	N9+00, E12+25	8.5K	
	N13+50, E12+50	16.7K	BOTTOM OF DITCH 19.5K cpm
	N13+25, E12+50	17.0K	
	N13+00, E12+50	15.4K	
	N12+75, E12+50	14.4K	
	N12+50, E12+50	13.6K	
	N12+25, E12+50	12.8K	
	N12+00, E12+50	12.1K	
	N11+75, E12+50	11.9K	
	N11+50, E12+50	11.4K	
	N11+25, E12+50	10.9K	
	N11+00, E12+50	10.4K	
	N10+75, E12+50	10.1K	
	N10+50, E12+50	9.8K	
	N10+25, E12+50	9.5K	
	N10+00, E12+50	9.3K	QUALITY CONTROL 9.09K cpm
	N9+75, E12+50	9.1K	
	N9+50, E12+50	9.8K	
	N9+25, E12+50	8.8K	
	N9+00, E12+50	8.9K	
	N13+50, E12+75	15.5K	BOTTOM OF DITCH 22.3K cpm
	N13+25, E12+75	16.2K	
	N13+00, E12+75	15.0K	
	N12+75, E12+75	13.9K	QUALITY CONTROL 13.4K cpm
	N12+50, E12+75	13.5K	
	N12+25, E12+75	12.9K	
	N12+00, E12+75	12.3K	
	N11+75, E12+75	11.6K	
	N11+50, E12+75	11.3K	
	N11+25, E12+75	10.9K	
	N11+00, E12+75	10.5K	
	N10+75, E12+75	10.2K	
	N10+50, E12+75	9.8K	
	N10+25, E12+75	9.8K	QUALITY CONTROL 9.63K cpm
	N10+00, E12+75	9.5K	
	N9+75, E12+75	8.9K	
	N9+50, E12+75	9.8K	
	N9+25, E12+75	9.1K	
	N9+00, E12+75	8.6K	
	N13+50, E13+00	15.4K	BOTTOM OF DITCH 21.5K cpm
	N13+25, E13+00	16.3K	
	N13+00, E13+00	14.6K	
	N12+75, E13+00	13.9K	
	N12+50, E13+00	13.1K	QUALITY CONTROL 13.0K cpm
	N12+25, E13+00	12.7K	
	N12+00, E13+00	11.8K	
	N11+75, E13+00	11.6K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+50, E13+00	11.1K	
	N11+25, E13+00	10.6K	
	N11+00, E13+00	10.2K	
	N10+75, E13+00	10.0K	
	N10+50, E13+00	9.8K	
	N10+25, E13+00	9.5K	
	N10+00, E13+00	9.1K	QUALITY CONTROL 9.05K cpm
	N9+75, E13+00	8.9K	
	N9+50, E13+00	10.4K	
	N9+25, E13+00	9.1K	
	N9+00, E13+00	9.3K	
	N13+50, E13+25	15.2K	BOTTOM OF DITCH 24.9K cpm
	N13+25, E13+25	16.1K	
	N13+00, E13+25	14.6K	
	N12+75, E13+25	14.2K	
	N12+50, E13+25	13.1K	
	N12+25, E13+25	12.5K	QUALITY CONTROL 12.7K cpm
	N12+00, E13+25	12.1K	
	N11+75, E13+25	11.5K	
	N11+50, E13+25	11.2K	
	N11+25, E13+25	10.9K	
	N11+00, E13+25	10.3K	
	N10+75, E13+25	10.0K	
	N10+50, E13+25	9.6K	
	N10+25, E13+25	9.2K	QUALITY CONTROL 9.37K cpm
	N10+00, E13+25	9.1K	
	N9+75, E13+25	8.8K	
	N9+50, E13+25	10.4K	
	N9+25, E13+25	9.4K	
	N9+00, E13+25	9.5K	
	N13+50, E13+50	15.5K	BOTTOM OF DITCH 21.5K cpm
	N13+25, E13+50	15.4K	
	N13+00, E13+50	14.1K	QUALITY CONTROL 14.3K cpm
	N12+75, E13+50	13.6K	
	N12+50, E13+50	13.0K	
	N12+25, E13+50	12.7K	
	N12+00, E13+50	11.9K	
	N11+75, E13+50	11.6K	
	N11+50, E13+50	11.0K	
	N11+25, E13+50	10.4K	
	N11+00, E13+50	13.0K	
	N10+75, E13+50	10.0K	
	N10+50, E13+50	9.5K	QUALITY CONTROL 9.36K cpm
	N10+25, E13+50	9.0K	
	N10+00, E13+50	8.8K	
	N9+75, E13+50	8.7K	
	N9+50, E13+50	9.9K	
	N9+25, E13+50	9.6K	
	N9+00, E13+50	8.9K	
	N13+50, E13+75	14.6K	BOTTOM OF DITCH 24.5K cpm
	N13+25, E13+75	15.6K	
	N13+00, E13+75	14.2K	
	N12+75, E13+75	13.7K	
	N12+50, E13+75	13.2K	
	N12+25, E13+75	12.5K	
	N12+00, E13+75	11.8K	QUALITY CONTROL 11.7K cpm
	N11+75, E13+75	11.7K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+50, E13+75	10.8K	
	N11+25, E13+75	10.6K	
	N11+00, E13+75	10.2K	
	N10+75, E13+75	9.8K	
	N10+50, E13+75	9.7K	
	N10+25, E13+75	9.4K	
	N10+00, E13+75	8.9K	
	N9+75, E13+75	8.5K	QUALITY CONTROL 8.63K cpm
	N9+50, E13+75	9.3K	
	N9+25, E13+75	8.8K	
	N9+00, E13+75	8.8K	
	N13+50, E14+00	15.8K	BOTTOM OF DITCH 21.8K cpm
	N13+25, E14+00	15.7K	QUALITY CONTROL 16.0K cpm
	N13+00, E14+00	13.9K	
	N12+75, E14+00	13.4K	
	N12+50, E14+00	12.8K	
	N12+25, E14+00	12.1K	
	N12+00, E14+00	11.7K	
	N11+75, E14+00	11.0K	
	N11+50, E14+00	10.7K	
	N11+25, E14+00	10.5K	
	N11+00, E14+00	10.0K	
	N10+75, E14+00	9.4K	QUALITY CONTROL 9.54K cpm
	N10+50, E14+00	9.4K	
	N10+25, E14+00	8.9K	
	N10+00, E14+00	9.1K	
	N9+75, E14+00	8.7K	
	N9+50, E14+00	9.8K	
	N9+25, E14+00	8.9K	
	N9+00, E14+00	8.8K	
	N13+50, E14+25	14.5K	BOTTOM OF DITCH 21.2K cpm
	N13+25, E14+25	15.1K	
	N13+00, E14+25	13.6K	
	N12+75, E14+25	13.1K	
	N12+50, E14+25	12.6K	
	N12+25, E14+25	12.2K	
	N12+00, E14+25	11.4K	
	N11+75, E14+25	11.1K	
	N11+50, E14+25	10.8K	QUALITY CONTROL 10.8K cpm
	N11+25, E14+25	10.2K	
	N11+00, E14+25	9.9K	
	N10+75, E14+25	9.6K	
	N10+50, E14+25	9.4K	
	N10+25, E14+25	9.1K	
	N10+00, E14+25	8.7K	
	N9+75, E14+25	8.7K	
	N9+50, E14+25	9.5K	
	N9+25, E14+25	9.0K	
	N9+00, E14+25	8.7K	QUALITY CONTROL 8.57K cpm
	N13+50, E14+50	15.0K	BOTTOM OF DITCH 17.2K cpm
	N13+25, E14+50	15.4K	
	N13+00, E14+50	13.6K	
	N12+75, E14+50	13.0K	
	N12+50, E14+50	12.4K	
	N12+25, E14+50	12,1K	
	N12+00, E14+50	11.5K	
	N11+75, E14+50	11.1K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+50, E14+50	10.4K	
	N11+25, E14+50	10.2K	QUALITY CONTROL 10.2K cpm
	N11+00, E14+50	9.8K	
	N10+75, E14+50	9.7K	
	N10+50, E14+50	9.5K	
	N10+25, E14+50	9.1K	
	N10+00, E14+50	8.9K	
	N9+75, E14+50	9.3K	
	N9+50, E14+50	9.1K	
	N9+25, E14+50	8.9K	
	N9+00, E14+50	8.6K	
	N13+50, E14+75	14.7K	BOTTOM OF DITCH 19.2K
	N13+25, E14+75	15.2K	QUALITY CONTROL 15.1K cpm
	N13+00, E14+75	13.7K	
	N12+75, E14+75	13.1K	
	N12+50, E14+75	12.0K	
	N12+25, E14+75	11.9K	
	N12+00, E14+75	11.4K	
	N11+75, E14+75	11.1K	
	N11+50, E14+75	10.5K	
	N11+25, E14+75	10.0K	
	N11+00, E14+75	9.8K	QUALITY CONTROL 9.79K cpm
	N10+75, E14+75	9.5K	
	N10+50, E14+75	9.4K	
	N10+25, E14+75	8.9K	
	N10+00, E14+75	8.9K	
	N9+75, E14+75	8.7K	
	N9+50, E14+75	9.0K	
	N9+25, E14+75	8.5K	
	N9+00, E14+75	8.7K	
	N13+50, E15+00	13.6K	BOTTOM OF DITCH 16.5K cpm
	N13+25, E15+00	15.0K	
	N13+00, E15+00	13.8K	
	N12+75, E15+00	12.8K	
	N12+50, E15+00	12.1K	
	N12+25, E15+00	11.8K	
	N12+00, E15+00	11.1K	
	N11+75, E15+00	10.8K	QUALITY CONTROL 10.7K cpm
	N11+50, E15+00	10.5K	
	N11+25, E15+00	10.2K	
	N11+00, E15+00	9.8K	
	N10+75, E15+00	9.5K	
	N10+50, E15+00	9.5K	
	N10+25, E15+00	9.0K	
	N10+00, E15+00	8.8K	
	N9+75, E15+00	9.0K	
	N9+50, E15+00	9.0K	
	N9+25, E15+00	8.1K	QUALITY CONTROL 8.15K cpm
	N9+00, E15+00	8.3K	
	N13+25, E15+25	14.1K	
	N13+00, E15+25	14.8K	QUALITY CONTROL 14.6K cpm
	N12+75, E15+25	17.2K	
	N12+50, E15+25	15.8K	
	N12+25, E15+25	18.2K	
	N12+00, E15+25	15.2K	
	N11+75, E15+25	13.1K	
	N11+50, E15+25	11.6K	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED GAMMA (gross - cpm)*	COMMENTS
WMU #4	N11+25, E15+25	10.8K	
	N11+00, E15+25	11.9K	
	N10+75, E15+25	11.6K	
	N10+50, E15+25	10.4K	QUALITY CONTROL 10.3K cpm
	N10+25, E15+25	10.4K	
	N10+00, E15+25	10.6K	
	N9+75, E15+25	9.5K	
	N9+50, E15+25	9.3K	
	N9+25, E15+25	9.5K	
	N9+00, E15+25	9.3K	

* (gross cpm) - gross counts per minute, includes background

ATTACHMENT 3-B
GAMMA WALKOVER SURVEY

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross - cpm)*	COMMENTS
WMU 7 & 30	N12+50, E10+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E10+00	8-10K	GRASS, GRAVEL
	N11+50, E10+00	8-10K	GRASS, GRAVEL
	N11+00, E10+00	8-10K	GRASS, GRAVEL
	N10+50, E10+00	8-10K	GRASS, GRAVEL, PAVEMENT
	N10+00, E10+00	8-10K	GRAVEL
	N9+50, E10+00	8-12K	GRASS, GRAVEL, PAVEMENT
	N9+00, E10+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E10+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E10+50	8-10K	GRASS, CEMENT
	N11+50, E10+50	8-12K	GRASS, MUD
	N11+00, E10+50	8-25K	GRASS, MUD
	N10+50, E10+50	8K-1 million cpm	GRASS, MUD, 1M cpm + HOT ROCKS ON SURFACE (N10+53, E10+78)
	N10+00, E10+50	8-12K	GRASS, GRAVEL, MUD
	N9+50, E10+50	8-120K	GRASS, GRAVEL, 120K "HOT SPOT" N9+94, E10+92
	N9+00, E10+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E11+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E11+00	N/A	NORTH PERIMETER DITCH; SURVEYED PRIOR
	" "	8K-13K cpm	GRASSY-WATER IN DITCH
	N11+50, E11+00	8K-12K cpm	GRASSY, MUD
	N11+00, E11+00	9K-16K cpm	GRASSY, MUD
	N10+50, E11+00	8K-13K cpm	GRASSY, MUD
	N10+00, E11+00	6K-13K	GRAVEL ROAD 6K-9K cpm GRASSY, MUD,
	N9+50, E11+00	10K-69K cpm	DITCH IS 41K-69K cpm / 10K-21K - AVG. N9+70, E11+5: 50K cpm N9+72, E11+12: 70K cpm-"HOT SPOT" N9+72, E11+22: 43K cpm N9+71, E11+30: 46K cpm GRASSY
	N9+00, E11+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E11+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E11+50	N/A	NORTH PERIMETER DITCH SURVEYED PRIOR
	" "	8K-13K cpm	GRASSY
	N11+50, E11+50	8K-12K cpm	GRASSY
	N11+00, E11+50	9K-13K cpm	GRASSY
	N10+50, E11+50	10K-13K cpm	GRASSY
	N10+00, E11+50	6K-124K cpm	GRAVEL RD. 6K-11K cpm N10+9, E11+97 (FLAGGED "HOT SPOT"): 124K cpm N10+10, E11+96: 63K cpm GRASS: 9K-16K cpm N10+7, E11+99: 40K cpm
	N9+50, E11+50	6K-55K cpm	GRASSY - GRAVEL RD. DITCH - 31K-55K cpm GRAVEL RD. 6K-11K cpm GRASS - 10K-16K cpm GRASSY - DITCH - GRAVEL RD.
	N9+00, E11+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E12+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E12+00	N/A	NORTH PERIMETER DITCH SURVEYED PRIOR
	" "	8K-20K cpm	GRASSY
	N11+50, E12+00	8K-13K cpm	GRASSY
	N11+00, E12+00	8K-38K cpm	GRASS - 8K-13K cpm N11+4, E12+18 (FLAGGED "HOT SPOT"), 38K cpm GRASSY
	N10+50, E12+00	9K-13K cpm	GRASSY

*(gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross - cpm)*	COMMENTS
WMU 7 & 30	N10+00, E12+00	7K-177K cpm	GRAVEL ROAD - 7K-13K cpm
			N10+2, E12+12: 34K cpm
			N10+6, E12+5 (FLAGGED "HOT SPOT"): 177K cpm
			N10+1, E12+35: 34K cpm
			GRASSY - GRAVEL RD.
	N9+50, E12+00	7K-55K cpm	GRAVEL RD. 7K-12K cpm
			DITCH - 30K-55K cpm
			GRASSY - GRAVEL RD. - DITCH
	N9+00, E12+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E12+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E12+50	N/A	NORTH PERIMETER DITCH SURVEYED PRIOR
	" "	9K-13K cpm	GRASSY
	N11+50, E12+50	8K-14K cpm	GRASSY - KNOLL
	N11+00, E12+50	9K-13K cpm	GRASSY
	N10+50, E12+50	10K-13K cpm	GRASSY
	N10+00, E12+50	9K-22K cpm	GRASSY, MUDDY
	N9+50, E12+50	7K-60K cpm	DITCH 30K-60K cpm / GRAVEL RD.: 7K-13K cpm
			N9+95, E12+94: 35K cpm
			N9+98, E12+76 TO 12+80 (LINE): 35K-37K cpm
			FLAGGED "HOT SPOT" N9+98, E12+78: 37K cpm
			GRASSY - GRAVEL RD. - DITCH
	N9+00, E12+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E13+00	N/A	PATROL RD #2 NO SURVEY NORTH OF N12+50
	N12+00, E13+00	--	SURVEYED PRIOR GRASS
	" "	10-140K	HOT SPOT N12+4, E13+25: 140K cpm
	N11+50, E13+00	10-15K	GRASS, MUD
	N11+00, E13+00	10-15K	GRASS, MUD
	N10+50, E13+00	10-15K	GRASS, MUD
	N10+00, E13+00	10-15K	GRASS, MUD
	N9+50, E13+00	8-35K	GRASS
	" "	30-60K	GRAVEL ROAD: HOT SPOT N9+70, E13+8: 60K cpm
	" "	8-20K	MUD
	N9+00, E13+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E13+50	N/A	PATROL RD #2 NO SURVEY NORTH OF N12+50
	N12+00, E13+50		SURVEYED PRIOR GRASS
	" "	10-15K	GRASS
	N11+50, E13+50	10-25K	GRASS
	N11+00, E13+50	10-15K	GRASS
	N10+50, E13+50	10-25K	GRASS, MUD
	N10+00, E13+50	8-45K	GRASS, GRAVEL, MUD
			HOT SPOT N10+34, E13+85: 45K cpm
	N9+50, E13+50	10-360K	GRASS, GRAVEL, MUD
			HOT SPOT N9+87, E13+85: 360K cpm
	N9+00, E13+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E14+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E14+00	--	SURVEYED PRIOR
	" "	10-23K	GRASS
	N11+50, E14+00	10-93K	HOT SPOT N11+75, E14+50: 93K cpm
	N11+00, E14+00	14-40K	HOT SPOT N11+38, E14+42: 40K cpm
	N10+50, E14+00	14-31K	HOT SPOT N10+57, E14+50: 31K cpm
	N10+00, E14+00	16-200K	HOT SPOT N10+40, E14+40: 200K cpm
			WITHIN THIS SECTION VARYING
			READINGS WERE OBSERVED
			42K - 200K cpm
	N9+50, E14+00	19K-575K cpm	GRASS, MUD/ DITCH: 30K-120K cpm
			N9+85, E14+49: 40K cpm
			N9+95, E14+43: 51K cpm
			N10+00, E14+40: 52K cpm
			N9+80, E14+5 GREEN SALTS: 575K cpm
			FLAGGED "HOT SPOT"
			N9+90, E14+3: 118K cpm

*(gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross - cpm)*	COMMENTS
WMU 7 & 30	N9+00, E14+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E14+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E14+50		N. PERIMETER DITCH SURVEYED PRIOR
	" "	15-110K	HOT SPOT N12+1, E14+74: 110K cpm
	N11+50, E14+50	10-160K	HOT SPOT N11+95, E14+55 (NOT FLAGGED); 160K cpm
	N11+00, E14+50	12-435K	GREEN SALTS: 300K cpm HOT SPOT N11+48, E14+85: 435K cpm (POINT SOURCE) UNDERGROUND
	N10+50, E14+50	10-78K	N10+99, E14+69: 78K cpm
	N10+00, E14+50	24-255K	N10+19, E14+95: 255K cpm
	N9+50, E14+50	28-120K	N9+91, E14+52: 120K cpm
	N9+00, E14+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E15+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E15+00		NORTH PERIMETER DITCH SURVEYED PRIOR
	" "	12-90K	GRASS - N12+4, E-15+10: 90K cpm
	N11+50, E15+00	20-240K	GRASS - N11+75, E15+1: 240K cpm
	N11+00, E15+00	20-500K	GRASS - N11+37, E15+19: 500K cpm
	N10+50, E15+00	12-15K	GRASS
	" "	10-12K	GRAVEL
	" "	15-970K	GRASS, MUD - N10+58, E15+25: 970K cpm
	N10+00, E15+00	25K-1 million cpm	GRASS, MUD N10+50, E15+30: 1.5 MILLION cpm
	N9+50, E15+00	25-400K	GRASS, GRAVEL N9+90, E15+35: 400K cpm
	N9+00, E15+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E15+50	N/A	NO SURVEY NORTH OF N12+50, PATROL RD #2
	N12+00, E15+50		NORTH PERIMETER DITCH SURVEYED PRIOR
	" "	12-18K	GRASS
	N11+50, E15+50	15-170K	N11+62, E15+92: 170K cpm
	N11+00, E15+50	18-200K	GRASS / N11+47, E15+90: 200K cpm
	N10+50, E15+50	14-290K	N10+59, E15+65: 290K cpm GRASS, GRAVEL
	N10+00, E15+50	15-375K	N10+76, E15+85; 375K cpm GRASS
	N9+50, E15+50	15-950K	N9+75, E15+99: 950K cpm GRASS, MUD
	N9+00, E15+50	N/A	NO SURVEY SOUTH OF N9+50
	N-12+50, E-16+00	N/A	NO SURVEY NORTH OF N12+50 (PATROL RD #2)
	N12+00, E16+00		NORTH PERIMETER DITCH: SURVEYED PRIOR
	" "	12-16K	GRASS
	N11+50, E16+00	16-180K	N11+75, E16+42: 180K cpm
	N11+00, E16+00	14-560K	N11+40, E16+45: 560K cpm
	N10+50, E16+00	13-220K	OXIDES N10+68, E16+49: 220K cpm
	N10+00, E16+00	16-360K	OXIDES N10+37, E16+44: 360K cpm
	N9+50, E16+00	18-650K	OXIDES ON SURFACE N9+85, E16+48: 650K cpm
	N9+00, E16+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E16+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E16+50	14-55K	HOT SPOT N12+1, E16+75: 55K cpm
	N11+50, E16+50	14-330K	HOT SPOT N11+65, E16+76: 330K cpm
	N11+00, E16+50	16-220K	OXIDES HOT SPOT N11+30, E16+70: 220K cpm

*(gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross - cpm)*	COMMENTS
WMU 7 & 30	N10+50, E16+50	15-570K	OXIDES HOT SPOT N10+98, E16+68: 570K cpm
	N10+00, E16+50	15-330K	OXIDES HOT SPOT N10+47, E16+60: 330K cpm
			CYLINDER (EMPTY)
	N9+50, E16+50	17-310K	OXIDES HOT SPOT N9+75, E16+73: 310K cpm
	N9+00, E16+50	N/A	NO SURVEY SOUTH ON N950
	N12+50, E17+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E17+00		NORTH PERIMETER DITCH: SURVEYED PRIOR
	" "	18-50K	GRASS - N12+48, E17+45: 50k cpm
	N11+50, E17+00	20-750K	GRASS - N11+54, E11+49: 750K cpm
	N11+00, E17+00	18-850K	GRASS - N11+47, E17+2: 850K cpm
	N10+50, E17+00	18-20K	GRASS-GROUND-MUD
	" "	10-12K	OXIDES ON SURFACE
	" "	20-300K	N10+62, E17+8: 300K cpm
	N10+00, E17+00	15-330K	GRASS, GRAVEL, RUBBLE
			OXIDES ON SURFACE
			N10+18, E17+18: 330K cpm
	N9+50, E17+00	25-900K	GRASS, MUD
			OXIDES ON SURFACE
			N9+85, E17+35: 900K cpm
	N9+00, E17+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E17+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E17+50		SURVEYED PRIOR
	" "	14-80K cpm	GRASS / N12+00, E17+99: 80K cpm
	N11+50, E17+50	30-860K	GRASS - OXIDES ON SURFACE
			N11+51, E17+70: 860K cpm
	N11+00, E17+50	18K-1.3 million cpm	GRASS, GRAVEL - OXIDES ON SURFACE
			N11+41, E17+65: 1.3 MILLION cpm
	N10+50, E17+50	10-12K	ON GRAVEL ROAD
	" "	18-40K	N11+00, E17+56: 40K cpm
			GRASS, MUD, GRAVEL
	N10+00, E17+50	10-140K	GRAVEL, GRASS, RUBBLE
			N10+30, E17+56: 140K cpm
	N9+50, E17+50	18K-1.7 million cpm	OXIDES ON SURFACE
			N9+77, E17+51: 1.7M cpm
	N9+00, E17+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E18+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E18+00	15-810K	OXIDES N12+2, E18+49: 810K cpm
	N11+50, E18+00	15-890K	OXIDES N11+75, E18+15: 890K cpm
	N11+00, E18+00	15-240K	OXIDES N11+45, E18+15: 240K cpm
	N10+50, E18+00	15-35K	OXIDES N10+75, E18+35: 350K cpm
	N10+00, E18+00	16-500K	OXIDES N10+49, E18+35: 500K cpm
			EMPTY TANKS / TANK TOPS
	N9+50, E18+00	18-110K	OXIDES N9+85, E18+20: 110K cpm
	N9+00, E18+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E18+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E18+50		NORTH PERMITER DITCH - SURVEYED PRIOR
	" "	14-430K	N12+5, E18+75: 430 K cpm
	N11+50, E18+50	16K-1.1m	N11+98, E18+80: 1.1M cpm
	N11+00, E18+50	14-100K	N11+49, E18+62: 100K cpm
	N10+50, E18+50	13-200K	N10+75, E18+80: 200K cpm
	N10+00, E18+50	16-150K	NOTE: THE SHINE EMITTED FROM BARREL PILE

*(gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross – cpm)*	COMMENTS
WMU 7 & 30			MADE DETERMINING ACTUAL GROUND
			CONTAMINATION AN IMPOSSIBILITY.
	N9+50, E18+50	16-83K	N9+75, E18+63: 83K cpm
	N9+00, E18+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E19+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E19+00		NORTH PERIMETER DITCH - SURVEYED PRIOR
	" "	15-43K	GRASS / N12+4, E19+12: 43K cpm
	N11+50, E19+00	20-110K	N11+65, E19+10: 110K cpm
	N11+00, E19+00	12-45K	GRASS, MUD, GRAVEL
	" "	15-19K	N11+15, E19+25: 45K cpm
	N10+50, E19+00	15-19K	
	" "	15-170K	GRASS, GRAVEL, MUD N10+85, E19+25: 170K cpm
	N10+00, E19+00	N/A	CRUSHED DRUM MOUND
	N9+50, E19+00	-	NO GAMMA RANGE GIVEN DUE TO EXCESSIVE
			SHINE FROM CRUSHED BARREL PILE
	N9+00, E19+00	N/A	NO SURVEY SOUTH N9+50
	N12+50, E19+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E19+50		NORTH PERIMETER DITCH - SURVEYED PRIOR
	" "	15-20K	GRASS
	N11+50, E19+50	18-220K	GRASS / N11+70, E19+55: 220K cpm
	N11+00, E19+50	18-35K	GRASS, MUD, GRAVEL
	" "	18-21K	N11+48, E19+85: 35K cpm
	N10+50, E19+50	-	NO GAMMA RANGE GIVEN DUE TO EXCESSIVE
			SHINE FROM CRUSHED BARREL PILE.
	N10+00, E19+50	N/A	CRUSHED DRUM MOUND
	N9+50, E19+50	-	NO GAMMA RANGE GIVEN DUE TO EXCESSIVE
			SHINE FROM CRUSHED BARREL PILE.
	N9+00, E19+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E20+00	N/A	NO SURVEY NORTH OF N12+50 (PATROL RD #2)
	N12+00, E20+00	15-115K	N12+2, E20+47: 115K cpm
	N11+50, E20+00	15-125K	N11+70, E20+15: 125K cpm
	N11+00, E20+00	16-260K	N11+20, E20+25: 260K cpm
	N10+50, E20+00	N/A	NOTE: EXCESSIVE SHINE
	N10+00, E20+00	N/A	CRUSHED DRUM MOUND
	N9+50, E20+00	N/A	NOTE: EXCESSIVE SHINE
	N9+00, E20+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E20+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E20+50		NORTH PERIMETER DITCH - SURVEYED PRIOR
	" "	18-200K	OXIDES N12+1, E20+95: 200K cpm
	N11+50, E20+50	17-600K	OXIDES N11+92, E20+52: 600K cpm
	N11+00, E20+50	16-110K	OXIDES N11+45, E20+99: 110K cpm
	N10+50, E20+50	N/A	NOTE: EXCESSIVE SHINE
	N10+00, E20+50	N/A	NOTE: EXCESSIVE SHINE
	N9+50, E20+50	N/A	NOTE: EXCESSIVE SHINE
	N9+00, E20+50	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E21+00	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E21+00		NORTH PERIMETER DITCH-SURVEYED PRIOR
	" "	30-120K	GRASS, MUD - N12+15, E21+46: 120K cpm
	N11+50, E21+00	18-200K	GRASS, GRAVEL, MUD
			N11+70, E21+45: 200K cpm
	N11+00, E21+00	18-167K	GRASS, GRAVEL, MUD
			N11+49, E21+48: 167K cpm

*(gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross - cpm)*	COMMENTS
WMU 7 & 30	N10+50, E21+00	18-530K	OXIDES ON SURFACE GRASS, GRAVEL - N10+59, E21+00: 530K cpm
	N10+00, E21+00	18-760K	OXIDES ON SURFACE GRASS, GRAVEL - N10+49, E21+1: 760K cpm
	N9+50, E21+00	20-100K	GRASS, MUD, GRAVEL - N9+95, E21+10: 100K cpm
	N9+00, E21+00	N/A	NO SURVEY SOUTH OF N9+50
	N12+50, E21+50	N/A	NO SURVEY NORTH OF N12+50
	N12+00, E21+50		NORTH PERIMETER DITCH: SURVEYED PRIOR
	" "	16-400K	N12+2, E21+53: 400K cpm
	N11+50, E21+50	30-315K	N11+90, E21+51: 315K cpm
	N11+00, E21+50	30-120K	N11+30, E12+51: 120K cpm
	N10+50, E21+50	15-18K	SURVEYED AREA WEST OF FENCE
	N10+00, E21+50	15-22K	SURVEYED AREA WEST OF FENCE
	N9+50, E21+50	N/A	NO SURVEY DUE TO EXCESSIVE SHINE FROM DRUM MOUND
	N9+00, E21+50	N/A	NO SURVEY SOUTH OF N9+50

*(gross cpm) - gross counts per minute, includes background

ATTACHMENT 3-B GAMMA MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	GAMMA SHIELDED (cpm-gross)*	COMMENTS
WMU #2 & 3 DITCHES	-0-	NORTH	15K	SPA-3 WITH CONESHIELD
	25W	CENTER	23K	
	50W	SOUTH	17K	
	75W	CENTER	18K	
	100W	NORTH	16K	
	125W	CENTER	21K	
	150W	SOUTH	18K	
	175W	CENTER	30K	
	200W	NORTH	32K	
	225W	CENTER	25K	
	250W	SOUTH	16K	
	275W	CENTER	20K	
	300W	NORTH	19K	
	325W	CENTER	25K	
	350W	SOUTH	17K	
	375W	CENTER	27K	
	400W	NORTH	44K	
	425W	CENTER	48K	
	450W	SOUTH	18K	
	425W	CENTER	52K	
	500W	NORTH	32K	
	525W	CENTER	104K	
	550W	SOUTH	19K	
	575W	CENTER	104K	
	600W	NORTH	20K	
	625W	CENTER	30K	
	650W	SOUTH	19K	
	675W	CENTER	32K	
	700W	NORTH	21K	
	725W	CENTER	35K	
	750W	SOUTH	25K	
	775W	CENTER	25K	
	800W	NORTH	22K	
	825W	CENTER	41K	
	850W	SOUTH	26K	
	875W	CENTER	48K	
	900W	NORTH	23K	
	925W	CENTER	56K	
	950W	SOUTH	26K	
	975W	CENTER	48K	
	1000W	NORTH	25K	
	1025W	CENTER	56K	
	1050W	SOUTH	28K	
	1075W	CENTER	57K	
	1100W	NORTH	22K	ROAD

*gross cpm-counts per minute includes background.

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	GAMMA SHIELDED (cpm-gross)*	COMMENTS
WMU #2&3 DITCHES	1125W	CENTER	26K	CULVERT
	1150W	SOUTH	52K	
	1175W	CENTER	54K	
	1200W	NORTH	28K	
	1225W	CENTER	54K	
	1250W	SOUTH	26K	
	1275W	CENTER	85K	
	1300W	NORTH	24K	
	1325W	CENTER	84K	
	1350W	SOUTH	24K	
	1375W	CENTER	92K	
	1400W	NORTH	22K	
	1425W	CENTER	112K	
	1450W	SOUTH	20K	
	1475W	CENTER	64K	
	1500W	NORTH	20K	
	1525W	CENTER	78K	
	1550W	SOUTH	17K	
	1575W	CENTER	48K	
	1600W	NORTH	16K	
	1625W	CENTER	12K	ROAD
	1650W	SOUTH	11K	ROAD
	1675W	CENTER	20K	FENCE

*gross cpm-counts per minute includes background.

ATTACHMENT 3–B
GAMMA WALKOVER SURVEY

AREA SURVEYED	SURVEY LOCATION COORDINATE	OBSERVED RANGE (gross – cpm)*	COMMENTS
DITCH SOUTH OF WMU 7 & 30	N9+00, E10+00	6-8K cpm	SCANNED BOTH SIDES OF PATROL ROAD NO ELEVATED AREAS DETECTED WEST OF ROAD OPENING IN CULVERT (NO ELEVATED RDGS) UNDERGROUND CULVERT / BULK HEAD (CONCRETE)
	N9+00, E10+50	10-20K cpm 20-40K cpm 8-10K cpm	ELEVATED COUNT RATES APPEAR IN DITCH BOTTOM & ~ 1/2 NORTH BANK, NO ELEVATED AREAS FOUND ON SOUTH BANK R/R TRACKS / BULK HEAD (CONCRETE)
	N9+00, E11+00	10-20K cpm 20-40K cpm 8-10K cpm	R/R TRACKS
	N9+00, E11+50	12-20K cpm 20-35K cpm 8-12K cpm	R/R TRACKS
	N9+00, E12+00	10-20K cpm 20-35K cpm 8-12K cpm	R/R TRACKS / CULVERT UNDER TRACKS
	N9+00, E12+50	12-20K cpm 20-35K cpm 8-12K cpm	R/R TRACKS / CULVERT UNDER TRACKS
	N9+00, E13+00	12-20K cpm 20-40K cpm 8-12K cpm	R/R TRACKS
	N9+00, E13+50	12-25k cpm 25-40K cpm 8-12K cpm	R/R TRACKS
	N9+00, E14+00	12-25K cpm 25-40K cpm 8-12K cpm	ELEVATED COUNT RATES APPEAR IN DITCH BOTTOM & ~ 1/2 WAY UP NORTH BANK, NO ELEVATED AREAS FOUND ON SOUTH BANK / R/R TRACKS
	N9+00, E14+50	12-20K cpm 20-35K cpm 8-12K cpm	R/R TRACKS
	N9+00, E15+00	12-25K cpm 25-40K cpm 8-12K cpm	R/R TRACKS / FENCE DITCH RUNS UNDER FENCE @ ~E1510 NO SURVEY PERFORMED BEYOND FENCE

* (gross cpm) – gross counts per minute, includes background

Attachment 3-C
G.M. MEASUREMENTS

ATTACHMENT 3-C – G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #1	N9+50, E10+00	42	34	R/R TRACKS (GRAVEL)
BKG TAKEN IN	N10+00, E10+00	47	43	
CENTER OF	N~10+30, E~10+03	507	359	HOT SPOT / SPA 3: 200Kcpm
4TH STREET	N~10+45, E~10+00	417	294	HOT SPOT / SPA 3: 180Kcpm
BKG = 60 cpm	N10+50, E10+00	161	80	
	N8+75, E10+25	43	32	R/R TRACKS (GRAVEL)
	N9+25, E10+25	62	45	
	N9+75, E10+25	55	57	
	N10+25, E10+25	75	73	
	N~10+27, E~10+17	228	198	HOT SPOT / SPA 3: 200Kcpm
	N~10+30, E~10+19	483	367	HOT SPOT / SPA 3: 290Kcpm
	N~10+32, E~10+25	1240	1023	HOT SPOT / SPA 3: 600Kcpm
	N~10+35, E~10+30	1184	952	HOT SPOT / SPA 3: 500Kcpm
	N~10+47, E~10+22	672	480	HOT SPOT / SPA 3: 500Kcpm
	N8+00, E10+50	48	42	R/R TRACKS
	N8+50, E10+50	50	46	
	N9+00, E10+50	75	56	
	N9+50, E10+50	64	53	
	N10+00, E10+50	63	64	
	N10+33, E10+40	566	595	HOT SPOT / SPA 3: 300Kcpm
	N10+50, E10+50	67	55	
	N8+25, E10+75	93	63	
	N8+75, E10+75	68	70	
	N9+25, E10+75	60	56	
	N9+75, E10+75	73	56	
	N10+25, E10+75	68	46	
	N10+44, E10+70	501	342	HOT SPOT / SPA 3: 160Kcpm
	N8+00, E11+00	56	39	
	N8+50, E11+00	72	47	
	N9+00, E11+00	58	54	
	N9+50, E11+00	50	35	
	N10+00, E11+00	59	44	
	N10+50, E11+00	62	48	
	N8+25, E11+25	47	34	
	N8+75, E11+25	54	50	
	N9+25, E11+25	55	48	
	N9+75, E11+25	51	41	
	N10+25, E11+25	56	49	
	N8+00, E11+50	44	35	
	N8+50, E11+50	49	35	
	N9+00, E11+50	45	31	
	N9+50, E11+50	41	38	
	N10+00, E11+50	54	47	
	N10+30, E11+60	198	89	HOT SPOT / SPA 3: 100Kcpm
	N10+50, E11+50	46	28	
	N8+25, E11+75	43	37	
	N8+75, E11+75	44	39	
	N9+25, E11+75	60	33	
	N9+75, E11+75	59	38	
	N10+25, E11+75	53	41	
	N10+35, E11+70	196	110	HOT SPOT / SPA 3: 100Kcpm
	N10+35, E11+75	162	114	HOT SPOT / SPA 3: 100Kcpm
	N10+35, E11+77	133	102	HOT SPOT / SPA 3: 100Kcpm
	N8+00, E12+00	33	43	
	N8+50, E12+00	52	41	
	N9+00, E12+00	52	46	
	N9+50, E12+00	57	35	
	N10+00, E12+00	48	35	
	N10+35, E11+90	171	93	HOT SPOT / SPA 3: 100Kcpm

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #1 BKG TAKEN IN CENTER OF 4TH STREET BKG = 60 cpm	N10+35, E11+98	165	120	HOT SPOT / SPA 3: 150Kcpm
	N10+34, E12+00	226	117	HOT SPOT / SPA 3: 130Kcpm
	N10+50, E12+00	39	42	
BKG TAKEN IN CENTER OF 4TH STREET BKG = 52 cpm	N8+25, E12+25	48	30	
	N8+75, E12+25	66	47	
	N9+25, E12+25	70	43	
	N9+75, E12+25	51	43	
	N10+25, E12+25	43	42	
	N10+34, E12+23	1042	748	HOT SPOT / SPA 3: 800Kcpm
	N10+36, E12+25	1228	1030	HOT SPOT / SPA 3: 1mill.+cpm
	N10+50, E12+25	825	706	HOT SPOT / SPA 3: 400Kcpm
	N8+00, E12+50	43	33	
	N8+50, E12+50	39	34	
	N9+00, E12+50	44	32	
	N9+50, E12+50	51	28	
	N9+79, E12+47	3989	393	HOT SPOT / SPA 3: 230Kcpm
	N10+00, E12+50	55	36	
	N10+36, E12+45	659	417	HOT SPOT / SPA 3: 350Kcpm
	N10+34, E12+47	983	539	HOT SPOT / SPA 3: 450Kcpm
	N10+34, E12+50	579	412	HOT SPOT / SPA 3: 400Kcpm
	N10+50, E12+50	57	46	
	N10+48, E12+47	11712	7535	HOT SPOT / 4mill.+cpm
	N8+25, E12+75	43	38	
	N8+75, E21+75	48	33	
	N9+25, E12+75	115	46	
	N9+56, E12+70	395	123	HOT SPOT / SPA 3: 102Kcpm
	N9+75, E12+75	41	36	
	N10+25, E12+75	79	53	
	N10+36, E12+65	366	332	HOT SPOT / SPA 3: 270Kcpm
	N10+42, E12+65	340	225	HOT SPOT / SPA 3: 178Kcpm
	N10+48, E12+69	327	198	HOT SPOT / SPA 3: 340K cpm
	N8+00, E13+00	52	45	
	N8+50, E13+00	48	40	
	N9+00, E13+00	37	32	
	N9+50, E13+00	62	27	
	N9+64, E13+09	433	155	HOT SPOT / SPA 3: 124Kcpm
	N9+64, E13+14	927	296	HOT SPOT / SPA 3: 203Kcpm
	N10+00, E13+00	52	49	
	N10+50, E13+00	55	30	
	N8+25, E13+25	45	41	
BKG TAKEN IN CENTER OF 4TH STREET BKG = 52 cpm	N8+75, E13+25	44	53	
	N9+25, E13+25	51	25	
	N9+75, E13+25	64	43	
	N10+25, E13+25	63	39	
	N10+50, E13+38	792	715	HOT SPOT / SPA 3: 441Kcpm
	N8+00, E13+50	46	41	
	N8+50, E13+50	49	38	
	N9+00, E13+50	49	38	
	N9+50, E13+50	43	43	
	N10+00, E13+50	50	42	
	N10+50, E13+50	30	36	
	N8+25, E13+75	61	41	
	N8+75, E13+75	42	36	
	N9+25, E13+75	43	26	
	N9+75, E13+75	60	51	
	N10+25, E13+75	41	36	

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #1	N8+50, E14+00	39	40	
´´G TAKEN IN	N9+00, E14+00	46	34	
'H STREET	N9+50, E14+00	44	37	
ɑKG = 52 cpm	N10+00, E14+00	60	36	
	N10+50, E14+00	41	33	
	N8+75, E14+25	50	31	
	N9+25, E14+25	38	38	
	N9+75, E14+25	39	42	
	N10+25, E14+25	71	42	
	N8+50, E14+50	29	39	
	N9+00, E14+50	50	41	
	N9+50, E14+50	56	43	
	N10+00, E14+50	42	48	
	N10+50, E14+50	43	27	
	N8+75, E14+75	67	26	
	N9+25, E14+75	42	35	
	N9+75, E14+75	53	43	
	N10+25, E14+75	64	58	
	N9+00, E15+00	75	46	
	N9+50, E15+00	45	37	
	N10+00, E15+00	37	29	
	N10+25, E15+03	265	110	HOT SPOT / SPA 3: 175Kcpm
	N10+50, E15+00	40	39	
	N9+25, E15+25	63	40	
	N9+75, E15+25	40	31	
	N10+25, E15+25	72	44	
	N10+45, E9+85	794	647	HOT SPOT / SPA 3: 790Kcpm
	N10+33, E9+86	235	161	HOT SPOT / SPA 3: 220Kcpm
	N10+51, E12+68	1006	884	HOT SPOT / SPA 3: 650Kcpm
	N10+51, E14+14	98	96	HOT SPOT / SPA 3: 121Kcpm

ATTACHMENT 3-C G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #4 BKG TAKEN IN CENTER OF 4TH STREET = 60 cpm	N9+25, E9+25**	65	62	**E9+37 OFFSET ~12' EAST, CENTER OF DITCH
	N9+75, E9+25**	85	37	
	N10+25, E9+25**	124	52	
	N10+75, E9+25**	103	53	
	N11+25, E9+25**	81	50	
	N11+75, E9+25**	226	62	
	N12+25, E9+25**	172	43	
	N12+75, E9+25**	119	56	
	N13+25, E9+25**	160	49	
	N9+00, E9+50	67	24	***E9+42 OFFSET ~17' EAST, CENTER OF DITCH
	N9+50, E9+50	92	41	
	N10+00, E9+50	58	30	
	N10+50, E9+50	47	39	
	N11+00, E9+50	74	53	
	N11+50, E9+50	59	44	
	N12+00, E9+50	62	43	
	N12+50, E9+50	64	42	
	N13+00, E9+50	56	45	
	N13+50, E9+50	90	41	
	N9+25, E9+75	54	38	
	N9+75, E9+75	63	32	
	N10+25, E9+75	47	43	
	N10+75, E9+75	48	40	
	N11+25, E9+75	42	40	
	N11+75, E9+75	54	48	
	N12+25, E9+75	59	46	
	N12+75, E9+75	48	46	
	N13+25, E9+75	73	32	
	N9+00, E10+00	37	35	
	N9+50, E10+00	118	46	
	N10+00, E10+00	64	34	
	N10+50, E10+00	56	45	
	N11+00, E10+00	45	44	
	N11+50, E10+00	57	49	
	N12+00, E10+00	54	39	
	N12+50, E10+00	64	41	
	N13+00, E10+00	47	46	
	N13+50, E10+00	56	44	
BKG TAKEN IN CENTER OF 4TH STREET = 55 cpm	N9+25, E10+25	54	43	
	N9+75, E10+25	46	45	
	N10+25, E10+25	52	47	
	N10+75, E10+25	37	41	
	N11+25, E10+25	40	46	Q.C. (SHIELDED) 47cpm
	N11+75, E10+25	53	37	
	N12+25, E10+25	54	51	
	N12+75, E10+25	47	44	
	N13+25, E10+25	58	56	
	N9+00, E10+50	57	43	Q.C. (SHIELDED) 36cpm
	N9+50, E10+50	77	27	
	N10+00, E10+50	51	34	
	N10+50, E10+50	52	35	
	N11+00, E10+50	56	40	
	N11+50, E10+50	63	49	Q.C. (SHIELDED) 41cpm
	N12+00, E10+50	56	40	
	N12+50, E10+50	47	39	
	N13+00, E10+50	58	49	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #4 BKG TAKEN IN -ENTER OF -H STREET = 55 cpm	N13+50, E10+50	69	38	
	N9+25, E10+75	38	39	Q.C. (SHIELDED) 44cpm
	N9+75, E10+75	49	39	
	N10+25, E10+75	53	52	
	N10+75, E10+75	45	38	
	N11+25, E10+75	31	45	
	N11+75, E10+75	63	39	Q.C. (SHIELDED) 42cpm
	N12+25, E10+75	48	47	
	N12+75, E10+75	43	50	
	N13+25, E10+75	57	46	
	N9+00, E11+00	48	29	
	N9+50, E11+00	158	64	Q.C. (SHIELDED) 49cpm
	N10+00, E11+00	58	53	
	N10+50, E11+00	54	31	
	N11+00, E11+00	33	35	
	N11+50, E11+00	47	51	
	N12+00, E11+00	47	41	Q.C. (SHIELDED) 38cpm
	N12+50, E11+00	39	41	
	N13+00, E11+00	53	48	
	N13+50, E11+00	65	57	
	N9+25, E11+25	54	44	
	N9+75, E11+25	40	38	Q.C. (SHIELDED) 43cpm
	N10+25, E11+25	40	41	
	N10+75, E11+25	53	45	
	N11+25, E11+25	53	26	
	N11+75, E11+25	68	37	
	N12+25, E11+25	56	44	Q.C. (SHIELDED) 46cpm
	N12+75, E11+25	57	45	
	N13+25, E11+25	52	46	
BKG TAKEN IN CENTER OF 4TH STREET = 51 CPM	N9+00, E11+50	52	29	
	N9+50, E11+50	43	43	
	N10+00, E11+50	72	38	
	N10+50, E11+50	54	42	
	N11+00, E11+50	41	26	Q.C. (SHIELDED) 39cpm
	N11+50, E11+50	72	47	
	N12+00, E11+50	71	34	
	N12+50, E11+50	46	49	
	N13+00, E11+50	60	42	
	N13+50, E11+50	125	48	Q.C. (SHIELDED) 43cpm
	N9+25, E11+75	63	41	
	N9+75, E11+75	53	43	
	N10+25, E11+75	39	31	
	N10+75, E11+75	55	39	
	N11+25, E11+75	69	50	
	N11+75, E11+75	49	37	Q.C. (SHIELDED) 33cpm
	N12+25, E11+75	38	38	
	N12+75, E11+75	61	34	
	N13+25, E11+75	50	48	
	N9+00, E12+00	57	41	
	N9+50, E12+00	65	47	Q.C. (SHIELDED) 43cpm
	N10+00, E12+00	60	33	
	N10+50, E12+00	59	38	
	N11+00, E12+00	48	47	
	N11+50, E12+00	40	33	
	N12+00, E12+00	50	38	Q.C. (SHIELDED) 38cpm
	N12+50, E12+00	42	37	
	N13+00, E12+00	53	46	
	N13+50, E12+00	111	47	
	N9+25, E12+25	63	52	
	N9+75, E12+25	49	42	Q.C. (SHIELDED) 31cpm
	N10+25, E12+25	52	38	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #4	N10+75, E12+25	47	42	
BKG TAKEN IN	N11+25, E12+25	54	38	
CENTER OF	N11+75, E12+25	57	35	
4TH STREET	N12+25, E12+25	53	32	Q.C. (SHIELDED) 48cpm
= 51 cpm	N12+75, E12+25	49	30	
	N13+25, E12+25	74	42	
BKG TAKEN IN	N9+00, E12+50	43	34	
CENTER OF	N9+50, E12+50	76	34	
6TH STREET	N10+00, E12+50	60	36	
= 57 CPM	N10+50, E12+50	45	41	
	N11+00, E12+50	70	49	Q.C. (SHIELDED) 44cpm
	N11+50, E12+50	50	42	
	N12+00, E12+50	45	43	
	N12+50, E12+50	43	37	
	N13+00, E12+50	61	47	
	N13+50, E12+50	122	36	Q.C. (SHIELDED) 46cpm
	N9+25, E12+75	59	39	
	N9+75, E12+75	46	38	
	N10+25, E12+75	49	44	
	N10+75, E12+75	54	47	
	N11+25, E12+75	60	44	Q.C. (SHIELDED) 48cpm
	N11+75, E12+75	39	61	
	N12+25, E12+75	43	39	
	N12+75, E12+75	49	38	
	N13+25, E12+75	45	49	
	N9+00, E13+00	60	47	Q.C. (SHIELDED) 41cpm
	N9+50, E13+00	76	33	
	N10+00, E13+00	53	39	
	N10+50, E13+00	52	37	
	N11+00, E13+00	50	29	
	N11+50, E13+00	53	46	Q.C. (SHIELDED) 42cpm
	N12+00, E13+00	51	44	
	N12+50, E13+00	53	38	
	N13+00, E13+00	67	51	
	N13+50, E13+00	101	44	
	N9+25, E13+25	79	41	Q.C. (SHIELDED) 35cpm
	N9+75, E13+25	55	41	
	N10+25, E13+25	56	28	
	N10+75, E13+25	60	46	
	N11+25, E13+25	62	41	
	N11+75, E13+25	41	32	Q.C. (SHIELDED) 38cpm
	N12+25, E13+25	45	51	
	N12+75, E13+25	44	52	
	N13+25, E13+25	44	43	
	N9+00, E13+50	77	51	
	N9+50, E13+50	52	37	Q.C. (SHIELDED) 36cpm
	N10+00, E13+50	62	43	
	N10+50, E13+50	49	36	
	N11+00, E13+50	42	38	
	N11+50, E13+50	61	31	
	N12+00, E13+50	52	37	Q.C. (SHIELDED) 54cpm
	N12+50, E13+50	60	50	
	N13+00, E13+50	67	35	
	N13+50, E13+50	112	43	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #4	N9+25, E13+75	57	46	
BKG TAKEN IN	N9+75, E13+75	56	45	Q.C. (SHIELDED) 48cpm
CENTER OF	N10+25, E13+75	46	32	
6TH STREET	N10+75, E13+75	36	36	
= 57 cpm	N11+25, E13+75	54	31	
	N11+75, E13+75	64	49	
	N12+25, E13+75	55	37	Q.C. (SHIELDED) 42cpm
	N12+75, E13+75	58	46	
	N13+25, E13+75	50	49	
	N9+00, E14+00	51	29	
	N9+50, E14+00	74	38	
	N10+00, E14+00	58	37	Q.C. (SHIELDED) 46cpm
	N10+50, E14+00	56	29	
	N11+00, E14+00	53	38	
	N11+50, E14+00	53	40	
	N12+00, E14+00	54	39	
	N12+50, E14+00	56	33	Q.C. (SHIELDED) 41cpm
	N13+00, E14+00	48	47	
	N13+50, E14+00	137	55	
BKG TAKEN IN	N9+25, E14+25	66	46	
CENTER OF	N9+75, E14+25	60	28	
6TH STREET	N10+25, E14+25	57	45	
= 59 CPM	N10+75, E14+25	52	44	
	N11+25, E14+25	61	40	Q.C. (SHIELDED) 43cpm
	N11+75, E14+25	56	37	
	N12+25, E14+25	53	41	
	N12+75, E14+25	57	40	
	N13+25, E14+25	57	38	
	N9+00, E14+50	54	29	Q.C. (SHIELDED) 31cpm
	N9+50, E14+50	68	37	
	N10+00, E14+50	59	46	
	N10+50, E14+50	34	36	
	N11+00, E14+50	45	45	
	N11+50, E14+50	57	37	Q.C. (SHIELDED) 28cpm
	N12+00, E14+50	40	35	
	N12+50, E14+50	59	51	
	N13+00, E14+50	52	37	
	N13+50, E14+50	117	48	
	N9+25, E14+75	61	31	Q.C. (SHIELDED) 40cpm
	N9+75, E14+75	56	41	
	N10+25, E14+75	66	33	
	N10+75, E14+75	70	42	
	N11+25, E14+75	50	40	
	N11+75, E14+75	65	40	Q.C. (SHIELDED) 41cpm
	N12+25, E14+75	53	49	
	N12+75, E14+75	52	40	
	N13+25, E14+75	58	55	
	N9+00, E15+00	59	43	
	N9+50, E15+00	80	31	Q.C. (SHIELDED) 40cpm
	N10+00, E15+00	43	47	
	N10+50, E15+00	44	32	
	N11+00, E15+00	45	35	
	N11+50, E15+00	64	42	
	N12+00, E15+00	68	42	Q.C. (SHIELDED) 32cpm
	N12+50, E15+00	56	28	
	N13+00, E15+00	30	38	
	N13+50, E15+00	111	40	

* (gross cpm) - gross counts per minute, includes background

AREA SURVEYED	SURVEY LOCATION COORDINATE		BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #4	N9+25, E15+25		94	45	
BKG TAKEN IN	N9+75, E15+25		56	41	Q.C. (SHIELDED) 38cpm
CENTER OF	N10+25, E15+25		109	43	
6TH STREET	N10+75, E15+25		99	52	
= 59 cpm	N11+25, E15+25		75	43	
	N11+75, E15+25		113	53	
	N2+25, E15+25		140	42	Q.C. (SHIELDED) 58cpm
	N12+75, E15+25		83	47	
	N13+25, E15+25		71	41	
NORTH DITCH AT	~N13+40, E9+75		86	49	BOTTOM OF DITCH
WMU #4	~N13+40, E10+25		82	57	BOTTOM OF DITCH
BKG TAKEN IN	~N14+40, E10+75		121	60	BOTTOM OF DITCH
CENTER OF	~N13+40, E11+25		139	51	BOTTOM OF DITCH
4TH STREET	~N13+40, E11+75		80	39	BOTTOM OF DITCH Q.C. (SHIELDED) 49cpm
= 61 cpm	~N13+40, E12+25		71	55	BOTTOM OF DITCH
	~N13+40, E12+75		191	45	BOTTOM OF DITCH
	~N13+40, E13+25		103	50	BOTTOM OF DITCH
	~N13+40, E13+75		162	60	BOTTOM OF DITCH
	~N13+40, E14+25		155	60	BOTTOM OF DITCH
	~N13+40, E14+75	C. 1	116	59	BOTTOM OF DITCH Q.C. (UNSHIELDED) 115cpm
	N8+92, E9+60		868	720	HOT SPOT

* (gross cpm) - gross counts per minute, includes background

ATTACHMENT 3-C G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30	N9+67, E10+50	CENTER	120	32	
SOUTH SWALE	N9+67, E11+00	SOUTH	150	40	
	N9+67, E11+25	CENTER	1163	39	
	N9+67, E11+50	NORTH	255	53	
	N9+67, E11+75	CENTER	733	89	
	N9+67, E12+00	SOUTH	547	75	
	N9+67, E12+25	CENTER	719	84	Q.C. (UNSHIELDED) 683 cpm
	N9+67, E12+50	NORTH	191	48	
	N9+67, E12+75	CENTER	487	75	
	N9+67, E13+00	SOUTH	62	27	
	N9+67, E13+25	CENTER	575	93	
	N9+67, E13+50	NORTH	150	41	Q.C. (UNSHIELDED) 34 cpm
	N9+67, E13+75	CENTER	292	45	
	N9+67, E14+00	SOUTH	81	29	
	N9+67, E14+25	CENTER	1742	204	
	N9+67, E14+50	NORTH	1688	182	
	N9+67, E14+75	CENTER	807	134	
	N9+67, E15+00	SOUTH	1526	136	Q.C. (UNSHIELDED) 1562 cpm
	N9+67, E15+25	CENTER	2375	253	
	N9+67, E15+50	NORTH	5710	392	
	N9+67, E15+75	CENTER	952	157	
	N9+67, E16+00	SOUTH	1637	185	
	N9+67, E16+25	CENTER	2860	214	Q.C. (SHIELDED) 186 cpm
	N9+67, E16+50	NORTH	2598	207	
	N9+67, E16+75	CENTER	3740	359	
	N9+67, E17+00	SOUTH	939	121	
	N9+67, E17+25	CENTER	1055	111	
	N9+67, E17+50	NORTH	19657	1972	
	N9+67, E17+75	CENTER	1008	119	
	N9+67, E18+00	SOUTH	197	45	
	N9+67, E18+25	CENTER	1001	106	
	N9+67, E18+50	NORTH	910	124	Q.C. (UNSHIELDED) 883 cpm
	N9+67, E18+75	CENTER	-	-	WATER ON SURFACE
	N9+67, E19+00	SOUTH	42	31	
	N9+67, E19+25	CENTER	-	-	WATER ON SURFACE
	N9+67, E19+50	NORTH	52	43	
	N9+67, E19+75	CENTER	-	-	WATER ON SURFACE
	N9+67, E20+00	SOUTH	430	51	
	N9+67, E20+25	CENTER	-	-	WATER ON SURFACE
	N9+67, E20+50	NORTH	538	71	
	N9+67, E20+75	CENTER	-	-	WATER ON SURFACE
	N9+67, E21+00	SOUTH	345	56	
	N9+67, E21+25	CENTER	-	-	WATER ON SURFACE
	N9+67, E21+50	NORTH	3470	376	
WMU #7 & 30	N9+75, E10+25		40	19	E. SIDE OF RD., (GRAVEL)
BKG. taken	N10+25, E10+25		37	30	E. SIDE OF RD., (GRAVEL)
@ center of	N10+75, E10+25		48	29	E. SIDE OF RD., (GRAVEL)
Patrol Rd #1	N11+25, E10+25		42	34	E. SIDE OF RD., (GRAVEL)
= 42 cpm	N11+75, E10+25		31	34	E. SIDE OF RD., (GRAVEL)
	N9+50, E10+50		118	38	SOUTH OF R/R TRACKS Q.C. (UNSHIELDED) 113 cpm
	N10+00, E10+50		21	29	GRAVEL
	N10+50, E10+50		63	37	
	N11+00, E10+50		55	29	
	N11+50, E10+50		52	42	
	N12+00, E10+50		49	26	Q.C. (SHIELDED) 33 cpm
	N9+75, E10+75		115	38	
	N10+25, E10+75		35	20	GRAVEL

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU 7 & 30	N10+53, E10+78		200,787	19,333	OXIDES ON SURFACE HOT SPOT SPA-3: 1M cpm
	N10+75, E10+75		76	30	
	N11+25, E10+75		29	30	
	N11+75, E10+75		50	38	
	N12+25, E10+75		53	41	
	N9+50, E11+00		34	41	CENTER OF R/R TRACKS
	N9+94, E10+92		1074	266	HOT SPOT SPA-3: 120K cpm Q.C. (UNSHIELDED) 1047 cpm
	N10+00, E11+00		78	34	
	N10+50, E11+00		121	44	
	N11+00, E11+00		62	32	
	N11+50, E11+00		63	22	
	N12+00, E11+00		52	32	Q.C. (SHIELDED) 26 cpm
	N9+72, E11+12		651	106	HOT SPOT SPA-3: 70K cpm
	N9+75, E11+25		328	77	
	N10+25, E11+25		86	42	
	N10+75, E11+25		81	34	
	N11+25, E11+25		56	45	
	N11+75, E11+25		54	30	
	N12+25, E11+25		59	55	
	N9+50, E11+50		46	25	NORTH OF R/R TRACKS
	N10+00, E11+50		125	32	Q.C. (UNSHIELDED) 142 cpm
	N10+50, E11+50		60	27	
	N11+00, E11+50		54	36	
	N11+50, E11+50		53	30	
	N12+00, E11+50		70	31	
	N9+75, E11+75		191	45	Q.C. (SHIELDED) 42 cpm
	N10+25, E11+75		134	30	
	N10+75, E11+75		75	40	
	N11+25, E11+75		34	42	
	N11+75, E11+75		39	23	
	N12+25, E11+75		66	33	
	N9+50, E12+00		45	26	CENTER OF R/R TRACKS
	N10+00, E12+00		36	41	
	N10+09, E11+97		387	126	HOT SPOT SPA-3: 124K cpm
	N10+06, E12+05		768	142	HOT SPOT SPA-3: 177K cpm Q.C. (UNSHIELDED) 778 cpm
	N10+50, E12+00		51	24	
	N11+00, E12+00		46	51	
	N11+50, E12+00		49	35	
	N12+00, E12+00		42	28	
	N9+75, E12+25		286	52	Q.C. (SHIELDED) 40 cpm
	N10+25, E12+25		64	28	
	N10+75, E12+25		62	29	
	N11+04, E12+18		213	60	HOT SPOT SPA-3: 38K cpm
	N11+25, E12+25		48	42	
	N11+75, E12+25		47	34	
	N12+25, E12+25		38	33	
	N9+50, E12+50		25	26	SOUTH OF R/R TRACKS
	N10+00, E12+50		130	38	
	N10+50, E12+50		56	23	Q.C. (UNSHIELDED) 50 cpm
	N11+00, E12+50		40	37	
	N11+50, E12+50		46	24	
	N12+00, E12+50		49	34	
	N9+75, E12+75		28	50	
	N9+98, E12+78		388	73	HOT SPOT SPA-3: 35-37K cpm Q.C. (SHIELDED) 80 cpm
	N10+25, E12+75		64	30	
	N10+75, E12+75		43	34	
	N11+25, E12+75		54	35	
	N11+75, E12+75		43	51	

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30	N12+25, E12+75		44	32	
`ENTER OF	N9+50, E13+00		47	31	CENTER OF R/R TRACKS
ROL RD. #1)	N9+70, E13+08		540	50	HOT SPOT SPA-3: 60K cpm
ʙKG.=42 cpm	N10+00, E13+00		125	66	
	N10+50, E13+00		92	41	Q.C. (UNSHIELDED) 90 cpm
	N11+00, E13+00		56	44	
	N11+50, E13+00		63	25	
	N12+00, E13+00		51	46	
	N9+75, E13+25		72	22	
	N10+25, E13+25		70	44	Q.C. (SHIELDED) 31 cpm
	N10+75, E13+25		58	32	
	N11+25, E13+25		53	30	
	N11+75, E13+25		40	42	
	N12+04, E13+25		782	313	HOT SPOT SPA-3: 140K cpm
	N12+25, E13+25		46	34	
	N9+50, E13+50		41	36	NORTH OF R/R TRACKS
	N10+00, E13+50		146	37	
	N10+50, E13+50		46	40	
	N11+00, E13+50		56	58	Q.C. (UNSHIELDED) 43 cpm
	N11+50, E13+50		42	36	
	N12+00, E13+50		68	44	
	N9+75, E13+75		135	50	
	N9+87, E13+85		7842	786	HOT SPOT SPA-3: 360K cpm
	N10+25, E13+75		60	51	Q.C. (SHIELDED) 30 cpm
	N10+34, E13+85		40,163	2318	HOT SPOT SPA-3: 45K cpm
	N10+75, E13+75		51	26	
	N11+25, E13+75		41	34	
	N11+75, E13+75		62	35	
	N12+25, E13+75		120	40	
	N9+50, E14+00		29	26	CENTER OF R/R TRACKS
	N9+80, E14+05		142,504	13,346	OXIDES ON SURFACE
					HOT SPOT SPA-3: 575K cpm
	N10+00, E14+00		714	79	DITCH
	N10+50, E14+00		82	30	Q.C. (UNSHIELDED) 105 cpm
	N11+00, E14+00		58	41	
	N11+50, E14+00		87	23	
	N12+00, E14+00		92	46	
	N9+75, E14+25		836	65	
	N10+25, E14+25		906	95	Q.C. (SHIELDED) 89 cpm
					DITCH
	N10+40, E14+40		866	331	HOT SPOT SPA-3: 200K cpm
	N10+75, E14+25		50	38	GRAVEL
	N11+25, E14+25		33	31	GRAVEL
	N11+38, E14+42		568	74	HOT SPOT SPA-3: 40K cpm
	N11+75, E14+25		35	36	GRAVEL
	N11+75, E14+50		951	120	HOT SPOT SPA-3: 93K cpm
	N12+25, E14+25		65	28	
	N9+50, E14+50		39	33	SOUTH OF R/R TRACKS
	N9+91, E14+52		885	200	HOT SPOT SPA-3: 120K cpm
					Q.C. (UNSHIELDED) 868 cpm
	N10+00, E14+50		284	59	
	N10+50, E14+50		442	60	
	N10+57, E14+50		691	96	HOT SPOT SPA-3: 31K cpm
	N11+00, E14+50		573	69	
	N11+50, E14+50		114	44	Q.C. (SHIELDED) 42 cpm
	N12+00, E14+50		706	76	
	N9+75, E14+75		553	75	
	N10+25, E14+75		276	58	
	N10+75, E14+75		27	48	GRAVEL

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30	N10+99, E14+69		174	95	HOT SPOT SPA-3: 78K cpm
(CENTER OF	N11+25, E14+75		52	22	
PATROL RD. #1)	N11+48, E14+85		5351	796	HOT SPOT SPA-3: 430K cpm
BKG.=42 cpm	N11+75, E14+75		613	80	
	N12+01, E14+74		3854	417	HOT SPOT SPA-3: 110K cpm Q.C. (UNSHIELDED) 4054 cpm
	N12+25, E14+75		54	28	
	N9+50, E15+00		36	38	CENTER OF R/R TRACKS
	N10+00, E15+00		209	65	
	N10+19, E14+95		1396	537	HOT SPOT SPA-3: 250K cpm
	N10+50, E15+00		809	76	Q.C. (SHIELDED) 86 cpm
	N11+00, E15+00		131	43	
	N11+50, E15+00		96	34	
	N12+00, E15+00		603	70	
	N11+75, E15+01		8602	289	HOT SPOT SPA-3: 240K cpm
	N9+75, E15+25		8761	662	
	N9+90, E15+35		92648	6427	OXIDES ON SURFACE HOT SPOT SPA-3: 400K cpm
	N10+25, E15+25		229	68	
	N10+50, E15+30		153156	15080	OXIDES ON SURFACE HOT SPOT SPA-3: 1M+ cpm
	N10+58, E15+25		101636	10381	OXIDES ON SURFACE HOT SPOT SPA-3: 970K cpm Q.C. (UNSHIELDED) 102431 cpm
	N10+75, E15+25		246	51	
	N11+25, E15+25		63	43	
	N11+37, E15+19		16906	1390	HOT SPOT SPA-3: 500K cpm
	N11+75, E15+25		243	32	
	N12+04, E15+10		630	112	HOT SPOT SPA-3: 90K cpm Q.C. (SHIELDED) 95 cpm
	N12+25, E15+25		140	49	
	N9+50, E15+50		60	25	NORTH OF R/R TRACKS
	N10+00, E15+50		134	72	
	N10+50, E15+50		830	141	
	N11+00, E15+50		63	38	
	N11+50, E15+50		82	25	
	N12+00, E15+50		198	57	
	N9+75, E15+75		2430	210	
	N10+25, E15+75		531	123	Q.C. (UNSHIELDED) 572 cpm
	N10+76, E15+85		124156	13865	OXIDES ON SURFACE HOT SPOT SPA-3: 375K cpm
	N10+59, E15+65		17852	1248	OXIDES ON SURFACE HOT SPOT SPA-3: 290K cpm
	N10+75, E15+75		169	51	
	N11+25, E15+75		91	35	
	N11+75, E15+75		198	39	Q.C. (SHIELDED) 61 cpm
	N12+25, E15+75		94	25	
	N9+50, E16+00		50	30	CENTER OF R/R TRACKS
	N9+75, E15+99		139388	16420	OXIDES ON SURFACE HOT SPOT SPA-3: 950K cpm
	N10+00, E16+00		96	41	
	N10+50, E16+00		209	50	
	N11+00, E16+00		145	35	DITCH
	N11+47, E15+90		2444	513	HOT SPOT SPA-3: 200K cpm
	N11+50, E16+00		123	62	
	N11+62, E15+92		768	224	HOT SPOT SPA-3: 170K cpm Q.C. (UNSHIELDED) 807 cpm
	N12+00, E16+00		78	35	
	N9+75, E16+25		3256	260	
	N9+85, E16+48		1649	1306	OXIDES ON SURFACE

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30					HOT SPOT SPA-3: 650K cpm
⁻ENTER OF	N10+25, E16+25		289	70	
ꟼOL RD. #1)	N10+37, E16+44		146214	14002	OXIDES ON SURFACE
ɒKG.=42 cpm					HOT SPOT SPA-3: 360K cpm
					Q.C. (SHIELDED) 13916 cpm
	N10+68, E16+49		69194	5280	OXIDES ON SURFACE
					HOT SPOT SPA-3: 220K cpm
	N10+75, E16+25		107	38	
	N11+25, E16+25		105	56	
	N11+75, E16+25		159	48	
	N11+75, E16+42		3086	300	HOT SPOT SPA-3: 180K cpm
	N12+25, E16+25		65	43	
	N9+50, E16+50	CENTER	38	25	
	N10+00, E16+50		76	28	
	N10+47, E16+60		157,074	17,393	HOT SPOT SPA-3: 330K cpm
	N10+50, E16+50		36	25	
	N10+98, E16+68		151,859	16,346	HOT SPOT SPA-3: 570K cpm
	N11+00, E16+50		152	89	
	N11+50, E16+50		141	79	
	N12+00, E16+50		128	61	
	N9+75, E16+73		2401	864	HOT SPOT SPA-3: 310K cpm
	N9+75, E16+75		724	170	
	N10+25, E16+75		67	52	
	N10+75, E16+75		169	50	
	N11+30, E16+70		3382	768	HOT SPOT SPA-3: 220K cpm
	N11+25, E16+75		253	57	
	N11+65, E16+76		12,340	1,175	HOT SPOT SPA-3: 330K cpm
	N11+75, E16+75		114	45	
	N12+01, E16+75		323	97	HOT SPOT SPA-3: 55K cpm
	N12+25, E16+75		117	57	
	N9+50, E17+00	NORTH	42	55	
	N10+00, E17+00		91	56	
	N10+18, E17+18		686	475	HOT SPOT SPA-3: 330K cpm
	N10+50, E17+00		86	57	
	N10+62, E17+08		36,431	2,878	HOT SPOT SPA-3: 300K cpm
	N11+00, E17+00		98	47	
	N11+47, E17+02		39,263	2,717	HOT SPOT SPA-3: 850K cpm
	N11+50, E17+00		276	73	
	N12+00, E17+00		278	51	
	N9+75, E17+25		890	172	
	N9+85, E17+35		218,845	27,142	HOT SPOT SPA-3: 900K cpm
	N10+25, E17+25		320	67	
	N10+75, E17+25		149	62	
	N11+25, E17+25		696	123	
	N11+54, E17+49		143,864	10,871	HOT SPOT SPA-3: 750K cpm
	N11+75, E17+25		432	67	
	N12+25, E17+25		2264	153	
	N12+38, E17+45		398	111	HOT SPOT SPA-3: 50K cpm
	N9+50, E17+50	CENTER	48	42	Q.C. (UNSHIELDED) 46 cpm
					Q.C. (SHIELDED) 37 cpm
	N9+77, E17+51		149,058	21,439	HOT SPOT SPA-3: 1.7M cpm
	N10+00, E17+50		126	93	
	N10+30, E17+56		931	432	HOT SPOT SPA-3: 140K cpm
	N10+50, E17+50		134	57	
	N11+00, E17+56		268	69	HOT SPOT SPA-3: 40K cpm
	N11+00, E17+50		89	50	
	N11+41, E17+65		111,381	5,648	HOT SPOT SPA-3: 1.3M cpm
	N11+50, E17+50		404	109	
	N11+51, E17+70		105,910	11,653	HOT SPOT SPA-3: 860K cpm

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30 (CENTER OF PATROL RD. #1) BKG.=42 cpm	N12+00, E17+50		1006	154	Q.C. (UNSHIELDED) 998 cpm Q.C. (SHIELDED) 130 cpm
	N12+00, E17+99		3922	367	Q.C. (UNSHIELDED) 3951 cpm Q.C. (SHIELDED) 318 cpm HOT SPOT SPA-3: 80K cpm
	N9+75, E17+75		70	81	
	N10+25, E17+75		180	47	
	N10+75, E17+75		115	43	
	N11+25, E17+75		860	120	
	N11+75, E17+75		104	31	
	N12+25, E17+75		515	78	
	N9+50, E18+00	SOUTH	65	32	
	N9+85, E18+20		39828	5728	Q.C. (UNSHIELDED) 39087 cpm Q.C. (SHIELDED) 5478 cpm HOT SPOT SPA-3: 110K cpm
	N10+00, E18+00		35	34	
	N10+49, E18+35		144,186	16,041	HOT SPOT SPA-3: 500K cpm
	N10+50, E18+00		265	63	
	N10+75, E18+35		70,729	6,160	HOT SPOT SPA-3 350K cpm
	N11+00, E18+00		22	31	GRAVEL ROAD
	N11+45, E18+15		6,944	1,675	HOT SPOT SPA-3: 240K cpm
	N11+50, E18+00		691	106	
	N11+75, E18+15		36,468	4,297	HOT SPOT SPA-3: 89K cpm
	N12+00, E18+00		6,529	530	
	N12+02, E18+49		216,138	27,993	HOT SPOT SPA-3: 810K cpm
	N9+75, E18+25		209	126	
	N10+25, E18+25		314	96	
	N10+75, E18+25		315	84	
	N11+25, E18+25		230	108	Q.C. (UNSHIELDED) 305 cpm Q.C. (SHIELDED) 103 cpm GRAVEL ROAD
	N11+75, E18+25		2,016	269	
	N12+25, E18+25		1,119	114	
	N9+50, E18+50	CENTER	24	55	
	N9+75, E18+63		3,945	326	HOT SPOT SPA-3: 83K cpm
	N10+00, E18+50		67	58	Q.C. (UNSHIELDED) 73 cpm Q.C. (SHIELDED) 61 cpm
	N10+50, E18+50		293	78	
	N10+75, E18+80		65625	3334	Q.C. (UNSHIELDED) 65128 cpm Q.C. (SHIELDED) 3383 cpm HOT SPOT SPA-3: 200K cpm
	N11+00, E18+50		37	56	
	N11+49, E18+62		4194	348	HOT SPOT SPA-3: 100K cpm
	N11+50, E18+50		45	51	GRAVEL ROAD
	N11+98, E18+80		23,510	4,193	HOT SPOT SPA-3: 1.1M cpm
	N12+00, E18+50		2,045	338	
	N12+05, E18+75		17,836	2,815	HOT SPOT SPA-3: 430K cpm
	N9+75, E18+75		89	56	
	N10+25, E18+75		N/A	N/A	BARREL PILE
	N10+75, E18+75		112	43	
	N11+25, E18+75		33	38	
	N11+75, E18+75		15,406	1,521	GRAVEL ROAD
	N12+25, E18+75		1970	165	Q.C. (UNSHIELDED) 1982 cpm Q.C. (SHIELDED) 204 cpm
	N9+50, E19+00		52	31	SOUTH OF R/R TRACKS
	N10+00, E19+00	N/A	N/A	N/A	DRUM MTN.
	N10+50, E19+00	N/A	N/A	N/A	DRUM MTN.
	N10+85, E19+25		11,138	809	HOT SPOT SPA-3: 170K cpm

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30	N11+00, E19+00		35	40	GRAVEL ROAD
·CENTER OF	N11+15, E19+25		958	135	HOT SPOT SPA-3: 45K cpm
·ROL RD. #1)	N11+50, E19+00		162	65	
·KG.=42 cpm	N11+65, E19+10		2463/2564	270/269	HOT SPOT SPA-3: 110K cpm
	N12+00, E19+00		110	38	
	N12+04, E19+12		685	102	HOT SPOT SPA-3: 43K cpm
	N9+75, E19+25		N/A	N/A	DRUM MTN.
	N10+25, E19+25		N/A	N/A	DRUM MTN.
	N10+75, E19+25		N/A	N/A	DRUM MTN.
	N11+25, E19+25		106	35	
	N11+75, E19+25		547	61	
	N12+25, E19+25		250	58	
	N9+50, E19+50		65	44	SOUTH OF R/R TRACKS
	N10+00, E19+50		N/A	N/A	DRUM MTN.
	N10+50, E19+50		N/A	N/A	DRUM MTN.
	N11+00, E19+50		38	54	GRAVEL ROAD
	N11+48, E19+85		258/271	84/91	HOT SPOT SPA-3: 35K cpm
	N11+50, E19+50		132	70	
	N11+70, E19+55		6409	414	HOT SPOT SPA-3: 220K cpm
	N12+00, E19+50		120	39	
	N9+75, E19+75		1,918	151	
	N10+25, E19+75		N/A	N/A	DRUM MTN.
	N10+75, E19+75		N/A	N/A	DRUM MTN.
	N11+25, E19+75		142	46	
	N11+75, E19+75		532	94	
	N12+25, E19+75		195	82	
	N9+50, E20+00		49	46	SOUTH OF R/R TRACKS
	N10+00, E20+00		N/A	N/A	DRUM MTN.
	N10+50, E20+00		N/A	N/A	DRUM MTN.
	N11+00, E20+00		34	44	GRAVEL ROAD
	N11+20, E20+25		4190/4110	435/438	HOT SPOT SPA-3: 260K cpm
	N11+50, E20+00		364	52	
	N11+70, E20+15		675	200	HOT SPOT SPA-3: 125K cpm
	N12+00, E20+00		103	58	
	N12+02, E20+47		3,325	268	HOT SPOT SPA-3: 115K cpm
	N9+75, E20+25		1710	123	
	N10+25, E20+25		N/A	N/A	DRUM MTN.
	N10+75, E20+25		N/A	N/A	DRUM MTN.
	N11+25, E20+25		109	53	
	N11+75, E20+25		186	66	
	N12+25, E20+25		328	65	
	N9+50, E20+50		63	34	
	N10+00, E20+50		N/A	N/A	DRUM MTN.
	N10+50, E20+50		N/A	N/A	DRUM MTN.
	N11+00, E20+50		26	52	GRAVEL ROAD
	N11+45, E20+99		635	200	Q.C. (UNSHIELDED) 560 cpm Q.C. (SHIELDED) 208 cpm HOT SPOT SPA-3: 110K cpm
	N11+50, E20+50		430	65	
	N11+92, E20+52		3,435	644	HOT SPOT SPA-3: 600K cpm
	N12+00, E20+50		1,134	83	
	N9+75, E20+75		11,712	1,117	
	N10+25, E20+75		N/A	N/A	DRUM MTN.
	N10+75, E20+75		2,153	164	
	N11+25, E20+75		348	60	
	N11+75, E20+75		202	65	
	N12+25, E20+75		118	52	

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #7 & 30 (CENTER OF PATROL RD. #1) BKG.=42 cpm	N9+50, E21+00		753	89	SOUTH OF R/R TRACKS
	N10+00, E21+00		916	145	
	N10+49, E21+01		175,536	17981	OXIDES ON SURFACE HOT SPOT SPA-3: 760K cpm Q.C. (SHIELDED) 17896 cpm
	N10+50, E21+00		2,281	306	
	N10+59, E21+00		152,046	12,097	OXIDES ON SURFACE HOT SPOT SPA-3: 530K cpm
	N11+00, E21+00		28	25	GRAVEL
	N11+50, E21+00		201	35	
	N12+00, E21+00		3,119	248	
	N12+01, E20+95		8,449	210	HOT SPOT SPA-3: 200K cpm
	N9+75, E21+25		119	30	OLD GRAVEL
	N10+25, E21+25		422	73	OLD GRAVEL
	N10+75, E21+25		39	28	Q.C. (UNSHIELDED) 51 cpm GRAVEL
	N11+25, E21+25		28	30	GRAVEL
	N11+75, E21+25		27	29	GRAVEL
	N12+25, E21+25		125	32	
	N9+50, E21+50		65	39	SOUTH OF R/R TRACKS
	N10+00, E21+50		106	44	Q.C. (SHIELDED) 39 cpm
	N10+50, E21+50		134	30	
	N11+00, E21+50		65	25	
	N11+30, E21+51		3,631	266	HOT SPOT SPA-3: 130K cpm
	N11+49, E21+48		5,736	474	HOT SPOT SPA-3: 167K cpm
	N11+50, E21+50		783	65	
	N11+70, E21+45		6,434	509	HOT SPOT SPA-3: 200K cpm
	N11+90, E21+51		5,412	661	HOT SPOT SPA-3: 315K cpm
	N12+00, E21+50		203	58	
	N12+02, E21+53		37346	1,423	HOT SPOT SPA-3: 400K cpm Q.C. (UNSHIELDED) 36866 cpm
	N12+15, E21+46		3,656	268	HOT SPOT SPA-3: 120K cpm

ATTACHMENT III G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
WMU #91	N9+50, E6+00	66	54	
BKG TAKEN	N10+00, E6+00	51	43	
IN CENTER	N10+50, E6+00	50	51	
OF VIRGINA ST.	N9+75, E6+25	66	41	
BKG=60cpm	N10+25, E6+25	60	37	
	N9+50, E6+50	54	54	Q.C. (UNSHIELDED) 50cpm
	N10+00, E6+50	49	44	
	N10+50, E6+50	51	54	
	N9+75, E6+75	65	41	
	N10+25, E6+75	59	48	
	N9+50, E7+00	52	43	
	N10+00, E7+00	78	73	Q.C. (SHIELDED) 59cpm
	N10+50, E7+00	67	44	
	N9+75, E7+25	60	60	
	N10+25, E7+25	81	81	
	N9+50, E7+50	58	50	
	N10+00, E7+50	79	51	
	N10+50, E7+50	95	66	
	N9+75, E7+75	67	58	
	N10+25, E7+75	65	61	Q.C. (UNSHIELDED) 70cpm
	N9+50, E8+00	80	53	
	N10+00, E8+00	91	69	
	N10+50, E8+00	113	69	
	N9+75, E8+25	86	56	
	N10+25, E8+25	62	50	Q.C. (SHIELDED) 45cpm
	N9+50, E8+50	73	41	
	N10+00, E8+50	67	46	
	N10+50, E8+50	68	80	
	N9+75, E8+75	58	65	
	N10+25, E8+75	57	55	
	N9+50, E9+00	58	35	
	N10+00, E9+00	88	79	
	N10+50, E9+00	82	53	
	N9+75, E9+25	63	58	Q.C. (UNSHIELDED) 67cpm
	N10+25, E9+25	73	49	
	N9+50, E9+50	54	49	
	N10+00, E9+50	70	62	
	N10+50, E9+50	89	87	
	N9+75, E9+75	59	48	Q.C. (SHIELDED) 61cpm
	N10+25, E9+75	78	57	
	N9+50, E10+00	69	49	
	N10+00, E10+00	73	73	
	N10+50, E10+00	99	82	
	N9+75, E10+25	90	61	
	N10+25, E10+25	52	53	
	N9+50, E10+50	172	84	
	N10+00, E10+50	55	59	
	N10+50, E10+50	106	58	Q.C. (UNSHIELDED) 90cpm

ATTACHMENT 3-C G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)*	BETA-GAMMA SHIELDED (cpm-gross)*	COMMENTS
DITCH SOUTH OF WMU #2 & 3	0 - WEST	NORTH	66	38	WEST SIDE OF ACCESS TO C-404 CYL. YARD
	50 - WEST	CENTER	186	74	
	100 - WEST	SOUTH	80	52	
	150 - WEST	CENTER	174	50	
	200 - WEST	NORTH	106	84	
	250 - WEST	CENTER	86	60	
	300 - WEST	SOUTH	56	48	
	350 - WEST	CENTER	84	50	
	400 - WEST	NORTH	556	108	
	450 - WEST	CENTER	160	88	
	500 - WEST	SOUTH	52	26	BRIDGE
	550 - WEST	CENTER	216	80	
	600 - WEST	NORTH	58	52	
	650 - WEST	CENTER	562	98	
	700 - WEST	SOUTH	72	56	
	750 - WEST	CENTER	230	88	
	800 - WEST	NORTH	52	46	
	850 - WEST	CENTER	214	114	
	900 - WEST	SOUTH	58	50	
	950 - WEST	CENTER	320	110	
	1000 - WEST	NORTH	64	44	
	1050 - WEST	CENTER	330	88	
	1075 - WEST	CENTER	196	94	CULVERT @ ~1075 UNDER ROAD
	1100 - WEST	N/A	N/A	N/A	ROAD
	1150 - WEST	SOUTH	326	278	
	1200 - WEST	CENTER	234	164	
	1250 - WEST	NORTH	60	24	
	1300 - WEST	CENTER	176	60	
	1350 - WEST	SOUTH	144	64	
	1400 - WEST	CENTER	420	188	
	1450 - WEST	NORTH	48	66	
	1500 - WEST	CENTER	554	118	
	1550 - WEST	SOUTH	64	64	
	1600 - WEST	CENTER	166	104	
	~1617 - WEST	CENTER	58	38	CULVERT
	1675 - WEST	NORTH	92	56	FENCE

ATTACHMENT 3-C G.M. MEASUREMENTS

AREA SURVEYED	SURVEY LOCATION COORDINATE	SIDE	BETA-GAMMA UNSHIELDED (cpm-gross)	BETA-GAMMA SHIELDED (cpm-gross)	COMMENTS
DITCH SOUTH OF WMU #7 & 30	N9+15, E10+50	CENTER	115	50	Background ~ 35 - 40 cpm
	N9+15, E10+75	SOUTH	54	39	
	N9+15, E11+00	CENTER	187	50	
	N9+15, E11+25	NORTH	42	39	
	N9+15, E11+50	CENTER	95	41	
	N9+15, E11+75	SOUTH	35	36	
	N9+15, E12+00	CENTER	111	53	
	N9+15, E12+25	NORTH	42	32	
	N9+15, E12+50	CENTER	41	39	
	N9+15, E12+75	SOUTH	39	29	
	N9+15, E13+00	CENTER	344	80	
	N9+15, E13+25	NORTH	55	42	
	N9+15, E13+50	CENTER	84	40	
	N9+15, E13+75	SOUTH	40	48	
	N9+15, E14+00	CENTER	175	53	
	N9+15, E14+25	NORTH	56	50	
	N9+15, E14+50	CENTER	292	60	
	N9+15, E14+75	SOUTH	44	34	
	N9+15, E15+00	CENTER	144	38	
	N9+15, E15+10	NORTH	94	32	END OF SURVEY @ FENCE (E-15+10)

Attachment 3-D
COORDINATE SYSTEM INTERCOMPARISON

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+00	9+50	–1718.0	–7108.8
9+50	9+50	–1768.0	–7108.2
10+00	10+00	–1717.4	–7058.8
9+50	10+00	–1767.4	–7058.2
9+00	10+00	–1817.4	–7057.6
8+50	10+00	–1867.4	–7056.9
8+00	10+00	–1917.4	–7056.3
10+00	10+50	–1716.8	–7008.8
9+50	10+50	–1766.8	–7008.2
9+00	10+50	–1816.7	–7007.6
8+50	10+50	–1866.7	–7006.9
8+00	10+50	–1916.7	–7006.3
10+00	11+00	–1716.1	–6958.8
9+50	11+00	–1766.1	–6958.2
9+00	11+00	–1816.1	–6957.6
8+50	11+00	–1866.1	–6956.9
8+00	11+00	–1916.1	–6956.3
10+00	11+50	–1715.5	–6908.8
9+50	11+50	–1765.5	–6908.2
9+00	11+50	–1815.5	–6907.6
8+50	11+50	–1865.5	–6906.9
8+00	11+50	–1915.5	–6906.3
10+00	12+00	–1714.9	–6858.8
9+50	12+00	–1764.9	–6858.2
9+00	12+00	–1814.9	–6857.6
8+50	12+00	–1864.9	–6856.9
8+00	12+00	–1914.9	–6856.3
10+00	12+50	–1714.3	–6808.8
9+50	12+50	–1764.3	–6808.2
9+00	12+50	–1814.3	–6807.6
8+50	12+50	–1864.3	–6807.0
8+00	12+50	–1914.3	–6806.3
10+00	13+00	–1713.7	–6758.8
9+50	13+00	–1763.7	–6758.2
9+00	13+00	–1813.7	–6757.6
8+50	13+00	–1863.7	–6757.0
8+00	13+00	–1913.7	–6756.3
10+00	13+50	–1713.1	–6708.8
9+50	13+50	–1763.1	–6708.2
9+00	13+50	–1813.1	–6707.6
8+50	13+50	–1863.1	–6707.0

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
8+00	13+50	-1913.1	-6706.3
10+00	14+00	-1712.4	-6658.8
9+50	14+00	-1762.4	-6658.2
9+00	14+00	-1812.4	-6657.6
8+50	14+00	-1862.4	-6657.0
8+00	14+00	-1912.4	-6656.3
10+00	14+50	-1711.8	-6608.8
9+50	14+50	-1761.8	-6608.2
9+50	14+50	-1761.8	-6608.2
8+50	14+50	-1861.8	-6607.0
10+00	15+00	-1711.2	-6558.8
9+50	15+00	-1761.2	-6558.2
9+00	15+00	-1811.2	-6557.6
8+50	15+00	-1861.2	-6557.0

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
13+25	9+37	-1168.8	-6488.2
13+00	9+37	-1193.8	-6488.3
12+75	9+37	-1218.8	-6488.5
12+50	9+37	-1243.8	-6488.7
12+25	9+37	-1268.8	-6488.9
12+00	9+37	-1293.8	-6489.0
11+75	9+37	-1318.7	-6489.2
11+50	9+37	-1343.7	-6489.4
11+25	9+37	-1368.7	-6489.6
11+00	9+37	-1393.7	-6489.8
10+75	9+37	-1418.7	-6489.9
10+50	9+37	-1443.7	-6490.1
10+25	9+37	-1468.7	-6490.3
10+00	9+37	-1493.7	-6490.5
9+75	9+37	-1518.7	-6490.6
9+50	9+37	-1543.7	-6490.8
9+25	9+37	-1568.7	-6491.0
9+00	9+37	-1593.7	-6491.2
13+50	9+50	-1143.9	-6475.0
13+25	9+50	-1168.9	-6475.2
13+00	9+50	-1193.9	-6475.3
12+75	9+50	-1218.9	-6475.5
12+50	9+50	-1243.9	-6475.7
12+25	9+50	-1268.8	-6475.9
12+00	9+50	-1293.8	-6476.0
11+75	9+50	-1318.8	-6476.2
11+50	9+50	-1343.8	-6476.4
11+25	9+50	-1368.8	-6476.6
11+00	9+50	-1393.8	-6476.8
10+75	9+50	-1418.8	-6476.9
10+50	9+25	-1443.6	-6502.1
10+25	9+50	-1468.8	-6477.3
10+00	9+50	-1493.8	-6477.5
9+75	9+50	-1518.8	-6477.6
9+50	9+50	-1543.8	-6477.8
9+25	9+50	-1568.8	-6478.0
9+00	9+50	-1593.8	-6478.2
13+50	9+75	-1144.1	-6450.0
13+25	9+75	-1169.1	-6450.2
13+00	9+75	-1194.0	-6450.4
12+75	9+75	-1219.0	-6450.5

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+50	9+75	-1244.0	-6450.7
12+25	9+75	-1269.0	-6450.9
12+00	9+75	-1294.0	-6451.1
11+75	9+75	-1319.0	-6451.2
11+50	9+75	-1344.0	-6451.4
11+25	9+75	-1369.0	-6451.6
11+00	9+75	-1394.0	-6451.8
10+75	9+75	-1419.0	-6451.9
10+50	9+75	-1444.0	-6452.1
10+25	9+75	-1469.0	-6452.3
10+00	9+75	-1494.0	-6452.5
9+75	9+75	-1519.0	-6452.6
9+50	9+75	-1544.0	-6452.8
9+25	9+75	-1569.0	-6453.0
9+00	9+75	-1593.9	-6453.2
13+50	10+00	-1144.2	-6425.0
13+25	10+00	-1169.2	-6425.2
13+00	10+00	-1194.2	-6425.4
12+75	10+00	-1219.2	-6425.5
12+50	10+00	-1244.2	-6425.7
12+25	10+00	-1269.2	-6425.9
12+00	10+00	-1294.2	-6426.1
11+75	10+00	-1319.2	-6426.2
11+50	10+00	-1344.2	-6426.4
11+25	10+00	-1369.2	-6426.6
11+00	10+00	-1394.2	-6426.8
10+75	10+00	-1419.2	-6426.9
10+50	10+00	-1444.2	-6427.1
10+25	10+00	-1469.2	-6427.3
10+00	10+00	-1494.1	-6427.5
9+75	10+00	-1519.1	-6427.6
9+50	10+00	-1544.1	-6427.8
9+25	10+00	-1569.1	-6428.0
9+00	10+00	-1594.1	-6428.2
13+50	10+25	-1144.4	-6400.0
13+25	10+25	-1169.4	-6400.2
13+00	10+25	-1194.4	-6400.4
12+75	10+25	-1219.4	-6400.5
12+50	10+25	-1244.4	-6400.7
12+25	10+25	-1269.4	-6400.9
12+00	10+25	-1294.4	-6401.1

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
11+75	10+25	−1319.4	−6401.2
11+50	10+25	−1344.4	−6401.4
11+25	10+25	−1369.4	−6401.6
11+00	10+25	−1394.3	−6401.8
10+75	10+25	−1419.3	−6401.9
10+50	10+25	−1444.3	−6402.1
10+25	10+25	−1469.3	−6402.3
10+00	10+25	−1494.3	−6402.5
9+75	10+25	−1519.3	−6402.7
9+50	10+25	−1544.3	−6402.8
9+25	10+25	−1569.3	−6403.0
9+00	10+25	−1594.3	−6403.2
13+50	10+50	−1144.6	−6375.0
13+25	10+50	−1169.6	−6375.2
13+00	10+50	−1194.6	−6375.4
12+75	10+50	−1219.6	−6375.5
12+50	10+50	−1244.6	−6375.7
12+25	10+50	−1269.6	−6375.9
12+00	10+50	−1294.5	−6376.1
11+75	10+50	−1319.5	−6376.3
11+50	10+50	−1344.5	−6376.4
11+25	10+50	−1369.5	−6376.6
11+00	10+50	−1394.5	−6376.8
10+75	10+50	−1419.5	−6377.0
10+50	10+50	−1444.5	−6377.1
10+25	10+50	−1469.5	−6377.3
10+00	10+50	−1494.5	−6377.5
9+75	10+50	−1519.5	−6377.7
9+50	10+50	−1544.5	−6377.8
9+25	10+50	−1569.5	−6378.0
9+00	10+50	−1594.5	−6378.2
13+50	10+75	−1144.8	−6350.0
13+25	10+75	−1169.8	−6350.2
13+00	10+75	−1194.7	−6350.4
12+75	10+75	−1219.7	−6350.6
12+50	10+75	−1244.7	−6350.7
12+25	10+75	−1269.7	−6350.9
12+00	10+75	−1294.7	−6351.1
11+75	10+75	−1319.7	−6351.3
11+50	10+75	−1344.7	−6351.4
11+25	10+75	−1369.7	−6351.6

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
11+00	10+75	-1394.7	-6351.8
10+75	10+75	-1419.7	-6352.0
10+50	10+75	-1444.7	-6352.1
10+25	10+75	-1469.7	-6352.3
10+00	10+75	-1494.7	-6352.5
9+75	10+75	-1519.7	-6352.7
9+50	10+75	-1544.7	-6352.8
9+25	10+75	-1569.7	-6353.0
9+00	10+75	-1594.6	-6353.2
13+50	11+00	-1144.9	-6325.0
13+25	11+00	-1169.9	-6325.2
13+00	11+00	-1194.9	-6325.4
12+75	11+00	-1219.9	-6325.6
12+50	11+00	-1244.9	-6325.7
12+25	11+00	-1269.9	-6325.9
12+00	11+00	-1294.9	-6326.1
11+75	11+00	-1319.9	-6326.3
11+50	11+00	-1344.9	-6326.4
11+25	11+00	-1369.9	-6326.6
11+00	11+00	-1394.9	-6326.8
10+75	11+00	-1419.9	-6327.0
10+50	11+00	-1444.9	-6327.1
10+25	11+00	-1469.9	-6327.3
10+00	11+00	-1494.8	-6327.5
9+75	11+00	-1519.8	-6327.7
9+50	11+00	-1544.8	-6327.8
9+25	11+00	-1569.8	-6328.0
9+00	11+00	-1594.8	-6328.2
13+50	11+25	-1145.1	-6300.0
13+25	11+25	-1170.1	-6300.2
13+00	11+25	-1195.1	-6300.4
12+75	11+25	-1220.1	-6300.6
12+50	11+25	-1245.1	-6300.7
12+25	11+25	-1270.1	-6300.9
12+00	11+25	-1295.1	-6301.1
11+75	11+25	-1320.1	-6301.3
11+50	11+25	-1345.1	-6301.4
11+25	11+25	-1370.1	-6301.6
11+00	11+25	-1395.1	-6301.8
10+75	11+25	-1420.0	-6302.0
10+50	11+25	-1445.0	-6302.1

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+25	11+25	-1470.0	-6302.3
10+00	11+25	-1495.0	-6302.5
9+75	11+25	-1520.0	-6302.7
9+50	11+25	-1545.0	-6302.9
9+25	11+25	-1570.0	-6303.0
9+00	11+25	-1595.0	-6303.2
13+50	11+50	-1145.3	-6275.0
13+25	11+50	-1170.3	-6275.2
13+00	11+50	-1195.3	-6275.4
12+75	11+50	-1220.3	-6275.6
12+50	11+50	-1245.3	-6275.7
12+25	11+50	-1270.3	-6275.9
12+00	11+50	-1295.3	-6276.1
11+75	11+50	-1320.2	-6276.3
11+50	11+50	-1345.2	-6276.5
11+25	11+50	-1370.2	-6276.6
11+00	11+50	-1395.2	-6276.8
10+75	11+50	-1420.2	-6277.0
10+50	11+50	-1445.2	-6277.2
10+25	11+50	-1470.2	-6277.3
10+00	11+50	-1495.2	-6277.5
9+75	11+50	-1520.2	-6277.7
9+50	11+50	-1545.2	-6277.9
9+25	11+50	-1570.2	-6278.0
9+00	11+50	-1595.2	-6278.2
13+50	11+75	-1145.5	-6250.0
13+25	11+75	-1170.5	-6250.2
13+00	11+75	-1195.5	-6250.4
12+75	11+75	-1220.4	-6250.6
12+50	11+75	-1245.4	-6250.8
12+25	11+75	-1270.4	-6250.9
12+00	11+75	-1295.4	-6251.1
11+75	11+75	-1320.4	-6251.3
11+50	11+75	-1345.4	-6251.5
11+25	11+75	-1370.4	-6251.6
11+00	11+75	-1395.4	-6251.8
10+75	11+75	-1420.4	-6252.0
10+50	11+75	-1445.4	-6252.2
10+25	11+75	-1470.4	-6252.3
10+00	11+75	-1495.4	-6252.5
9+75	11+75	-1520.4	-6252.7

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	11+75	-1545.4	-6252.9
9+25	11+75	-1570.4	-6253.0
9+00	11+75	-1595.4	-6253.2
13+50	12+00	-1145.6	-6225.1
13+25	12+00	-1170.6	-6225.2
13+00	12+00	-1195.6	-6225.4
12+75	12+00	-1220.6	-6225.6
12+50	12+00	-1245.6	-6225.8
12+25	12+00	-1270.6	-6225.9
12+00	12+00	-1295.6	-6226.1
11+75	12+00	-1320.6	-6226.3
11+50	12+00	-1345.6	-6226.5
11+25	12+00	-1370.6	-6226.6
11+00	12+00	-1395.6	-6226.8
10+75	12+00	-1420.6	-6227.0
10+50	12+00	-1445.6	-6227.2
10+25	12+00	-1470.6	-6227.3
10+00	12+00	-1495.6	-6227.5
9+75	12+00	-1520.5	-6227.7
9+50	12+00	-1545.5	-6227.9
9+25	12+00	-1570.5	-6228.0
9+00	12+00	-1595.5	-6228.2
13+50	12+25	-1145.8	-6200.1
13+25	12+25	-1170.8	-6200.2
13+00	12+25	-1195.8	-6200.4
12+75	12+25	-1220.8	-6200.6
12+50	12+25	-1245.8	-6200.8
12+25	12+25	-1270.8	-6200.9
12+00	12+25	-1295.8	-6201.1
11+75	12+25	-1320.8	-6201.3
11+50	12+25	-1345.8	-6201.5
11+25	12+25	-1370.8	-6201.6
11+00	12+25	-1395.8	-6201.8
10+75	12+25	-1420.7	-6202.0
10+50	12+25	-1445.7	-6202.2
10+25	12+25	-1470.7	-6202.4
10+00	12+25	-1495.7	-6202.5
9+75	12+25	-1520.7	-6202.7
9+50	12+25	-1545.7	-6202.9
9+25	12+25	-1570.7	-6203.1
9+00	12+25	-1595.7	-6203.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
13+50	12+50	-1146.0	-6175.1
13+25	12+50	-1171.0	-6175.2
13+00	12+50	-1196.0	-6175.4
12+75	12+50	-1221.0	-6175.6
12+50	12+50	-1246.0	-6175.8
12+25	12+50	-1271.0	-6175.9
12+00	12+50	-1296.0	-6176.1
11+75	12+50	-1321.0	-6176.3
11+50	12+50	-1345.9	-6176.5
11+25	12+50	-1370.9	-6176.7
11+00	12+50	-1395.9	-6176.8
10+75	12+50	-1420.9	-6177.0
10+50	12+50	-1445.9	-6177.2
10+25	12+50	-1470.9	-6177.4
10+00	12+50	-1495.9	-6177.5
9+75	12+50	-1520.9	-6177.7
9+50	12+50	-1545.9	-6177.9
9+25	12+50	-1570.9	-6178.1
9+00	12+50	-1595.9	-6178.2
13+50	12+75	-1146.2	-6150.1
13+25	12+75	-1171.2	-6150.2
13+00	12+75	-1196.2	-6150.4
12+75	12+75	-1221.2	-6150.6
12+50	12+75	-1246.1	-6150.8
12+25	12+75	-1271.1	-6151.0
12+00	12+75	-1296.1	-6151.1
11+75	12+75	-1321.1	-6151.3
11+50	12+75	-1346.1	-6151.5
11+25	12+75	-1371.1	-6151.7
11+00	12+75	-1396.1	-6151.8
10+75	12+75	-1421.1	-6152.0
10+50	12+75	-1446.1	-6152.2
10+25	12+75	-1471.1	-6152.4
10+00	12+75	-1496.1	-6152.5
9+75	12+75	-1521.1	-6152.7
9+50	12+75	-1546.1	-6152.9
9+25	12+75	-1571.1	-6153.1
9+00	12+75	-1596.1	-6153.2
13+50	13+00	-1146.3	-6125.1
13+25	13+00	-1171.3	-6125.3
13+00	13+00	-1196.3	-6125.4

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID NORTH	EAST	PLANT GRID NORTH	EAST
12+75	13+00	−1221.3	−6125.6
12+50	13+00	−1246.3	−6125.8
12+25	13+00	−1271.3	−6126.0
12+00	13+00	−1296.3	−6126.1
11+75	13+00	−1321.3	−6126.3
11+50	13+00	−1346.3	−6126.5
11+25	13+00	−1371.3	−6126.7
11+00	13+00	−1396.3	−6126.8
10+75	13+00	−1421.3	−6127.0
10+50	13+00	−1446.3	−6127.2
10+25	13+00	−1471.3	−6127.4
10+00	13+00	−1496.3	−6127.5
9+75	13+00	−1521.3	−6127.7
9+50	13+00	−1546.2	−6127.9
9+25	13+00	−1571.2	−6128.1
9+00	13+00	−1596.2	−6128.3
13+50	13+25	−1146.5	−6100.1
13+25	13+25	−1171.5	−6100.3
13+00	13+25	−1196.5	−6100.4
12+75	13+25	−1221.5	−6100.6
12+50	13+25	−1246.5	−6100.8
12+25	13+25	−1271.5	−6101.0
12+00	13+25	−1296.5	−6101.1
11+75	13+25	−1321.5	−6101.3
11+50	13+25	−1346.5	−6101.5
11+25	13+25	−1371.5	−6101.7
11+00	13+25	−1396.5	−6101.8
10+75	13+25	−1421.5	−6102.0
10+50	13+25	−1446.4	−6102.2
10+25	13+25	−1471.4	−6102.4
10+00	13+25	−1496.4	−6102.6
9+75	13+25	−1521.4	−6102.7
9+50	13+25	−1546.4	−6102.9
9+25	13+25	−1571.4	−6103.1
9+00	13+25	−1596.4	−6103.3
13+50	13+50	−1146.7	−6075.1
13+25	13+50	−1171.7	−6075.3
13+00	13+50	−1196.7	−6075.4
12+75	13+50	−1221.7	−6075.6
12+50	13+50	−1246.7	−6075.8
12+25	13+50	−1271.7	−6076.0

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+00	13+50	-1296.7	-6076.1
11+75	13+50	-1321.7	-6076.3
11+50	13+50	-1346.6	-6076.5
11+25	13+50	-1371.6	-6076.7
11+00	13+50	-1396.6	-6076.9
10+75	13+50	-1421.6	-6077.0
10+50	13+50	-1446.6	-6077.2
10+25	13+50	-1471.6	-6077.4
10+00	13+50	-1496.6	-6077.6
9+75	13+50	-1521.6	-6077.7
9+50	13+50	-1546.6	-6077.9
9+25	13+50	-1571.6	-6078.1
9+00	13+50	-1596.6	-6078.3
13+50	13+75	-1146.9	-6050.1
13+25	13+75	-1171.9	-6050.3
13+00	13+75	-1196.9	-6050.5
12+75	13+75	-1221.9	-6050.6
12+50	13+75	-1246.8	-6050.8
12+25	13+75	-1271.8	-6051.0
12+00	13+75	-1296.8	-6051.2
11+75	13+75	-1321.8	-6051.3
11+50	13+75	-1346.8	-6051.5
11+25	13+75	-1371.8	-6051.7
11+00	13+75	-1396.8	-6051.9
10+75	13+75	-1421.8	-6052.0
10+50	13+75	-1446.8	-6052.2
10+25	13+75	-1471.8	-6052.4
10+00	13+75	-1496.8	-6052.6
9+75	13+75	-1521.8	-6052.7
9+50	13+75	-1546.8	-6052.9
9+25	13+75	-1571.8	-6053.1
9+00	13+75	-1596.8	-6053.3
13+50	14+00	-1147.1	-6025.1
13+25	14+00	-1172.0	-6025.3
13+00	14+00	-1197.0	-6025.5
12+75	14+00	-1222.0	-6025.6
12+50	14+00	-1247.0	-6025.8
12+25	14+00	-1272.0	-6026.0
12+00	14+00	-1297.0	-6026.2
11+75	14+00	-1322.0	-6026.3
11+50	14+00	-1347.0	-6026.5

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
11+25	14+00	-1372.0	-6026.7
11+00	14+00	-1397.0	-6026.9
10+75	14+00	-1422.0	-6027.0
10+50	14+00	-1447.0	-6027.2
10+25	14+00	-1472.0	-6027.4
10+00	14+00	-1497.0	-6027.6
9+75	14+00	-1522.0	-6027.7
9+50	14+00	-1547.0	-6027.9
9+25	14+00	-1571.9	-6028.1
9+00	14+00	-1596.9	-6028.3
13+50	14+25	-1147.2	-6000.1
13+25	14+25	-1172.2	-6000.3
13+00	14+25	-1197.2	-6000.5
12+75	14+25	-1222.2	-6000.6
12+50	14+25	-1247.2	-6000.8
12+25	14+25	-1272.2	-6001.0
12+00	14+25	-1297.2	-6001.2
11+75	14+25	-1322.2	-6001.3
11+50	14+25	-1347.2	-6001.5
11+25	14+25	-1372.2	-6001.7
11+00	14+25	-1397.2	-6001.9
10+75	14+25	-1422.2	-6002.0
10+50	14+25	-1447.2	-6002.2
10+25	14+25	-1472.1	-6002.4
10+00	14+25	-1497.1	-6002.6
9+75	14+25	-1522.1	-6002.8
9+50	14+25	-1547.1	-6002.9
9+25	14+25	-1572.1	-6003.1
9+00	14+25	-1597.1	-6003.3
13+50	14+50	-1147.4	-5975.1
13+25	14+50	-1172.4	-5975.3
13+00	14+50	-1197.4	-5975.5
12+75	14+50	-1222.4	-5975.6
12+50	14+50	-1247.4	-5975.8
12+25	14+50	-1272.4	-5976.0
12+00	14+50	-1297.4	-5976.2
11+75	14+50	-1322.4	-5976.4
11+50	14+50	-1347.4	-5976.5
11+25	14+50	-1372.3	-5976.7
11+00	14+50	-1397.3	-5976.9
10+75	14+50	-1422.3	-5977.1

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+50	14+50	-1447.3	-5977.2
10+25	14+50	-1472.3	-5977.4
10+00	14+50	-1497.3	-5977.6
9+75	14+50	-1522.3	-5977.8
9+50	14+50	-1547.3	-5977.9
9+25	14+50	-1572.3	-5978.1
9+00	14+50	-1597.3	-5978.3
13+50	14+75	-1147.6	-5950.1
13+25	14+75	-1172.6	-5950.3
13+00	14+75	-1197.6	-5950.5
12+75	14+75	-1222.6	-5950.7
12+50	14+75	-1247.6	-5950.8
12+25	14+75	-1272.5	-5951.0
12+00	14+75	-1297.5	-5951.2
11+75	14+75	-1322.5	-5951.4
11+50	14+75	-1347.5	-5951.5
11+25	14+75	-1372.5	-5951.7
11+00	14+75	-1397.5	-5951.9
10+75	14+75	-1422.5	-5952.1
10+50	14+75	-1447.5	-5952.2
10+25	14+75	-1472.5	-5952.4
10+00	14+75	-1497.5	-5952.6
9+75	14+75	-1522.5	-5952.8
9+50	14+75	-1547.5	-5952.9
9+25	14+75	-1572.5	-5953.1
9+00	14+75	-1597.5	-5953.3
13+50	15+00	-1147.8	-5925.1
13+25	15+00	-1172.7	-5925.3
13+00	15+00	-1197.7	-5925.5
12+75	15+00	-1222.7	-5925.7
12+50	15+00	-1247.7	-5925.8
12+25	15+00	-1272.7	-5926.0
12+00	15+00	-1297.7	-5926.2
11+75	15+00	-1322.7	-5926.4
11+50	15+00	-1347.7	-5926.5
11+25	15+00	-1372.7	-5926.7
11+00	15+00	-1397.7	-5926.9
10+75	15+00	-1422.7	-5927.1
10+50	15+00	-1447.7	-5927.2
10+25	15+00	-1472.7	-5927.4
10+00	15+00	-1497.7	-5927.6

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+75	15+00	-1522.7	-5927.8
9+50	15+00	-1547.7	-5927.9
9+25	15+00	-1572.6	-5928.1
9+00	15+00	-1597.6	-5928.3
13+50	15+25	-1147.9	-5900.1
13+25	15+25	-1172.9	-5900.3
13+00	15+25	-1197.9	-5900.5
12+75	15+25	-1222.9	-5900.7
12+50	15+25	-1247.9	-5900.8
12+25	15+25	-1272.9	-5901.0
12+00	15+25	-1297.9	-5901.2
11+75	15+25	-1322.9	-5901.4
11+50	15+25	-1347.9	-5901.5
11+25	15+25	-1372.9	-5901.7
11+00	15+25	-1397.9	-5901.9
10+75	15+25	-1422.9	-5902.1
10+50	15+25	-1447.9	-5902.2
10+25	15+25	-1472.9	-5902.4
10+00	15+25	-1497.8	-5902.6
9+75	15+25	-1522.8	-5902.8
9+50	15+25	-1547.8	-5903.0
9+25	15+25	-1572.8	-5903.1
9+00	15+25	-1597.8	-5903.3

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+50	10+00	1026.6	-7277.2
12+00	10+00	976.6	-7278.3
11+50	10+00	926.6	-7279.5
11+00	10+00	876.7	-7280.6
10+50	10+00	826.7	-7281.7
10+00	10+00	776.7	-7282.8
9+50	10+00	726.7	-7283.9
9+00	10+00	676.7	-7285.0
12+50	10+50	1025.5	-7227.2
12+00	10+50	975.5	-7228.4
11+50	10+50	925.5	-7229.5
11+00	10+50	875.5	-7230.6
10+50	10+50	825.6	-7231.7
10+00	10+50	775.6	-7232.8
9+50	10+50	725.6	-7233.9
9+00	10+50	675.6	-7235.0
12+50	11+00	1024.4	-7177.3
12+00	11+00	974.4	-7178.4
12+00	11+00	974.4	-7178.4
11+50	11+00	924.4	-7179.5
11+00	11+00	874.4	-7180.6
10+50	11+00	824.4	-7181.7
10+00	11+00	774.5	-7182.8
9+50	11+00	724.5	-7183.9
9+00	11+00	674.5	-7185.1
12+50	11+50	1023.3	-7127.3
12+00	11+50	973.3	-7128.4
12+00	11+50	973.3	-7128.4
11+50	11+50	923.3	-7129.5
11+00	11+50	873.3	-7130.6
10+50	11+50	823.3	-7131.7
10+00	11+50	773.3	-7132.8
9+50	11+50	723.4	-7134.0
9+00	11+50	673.4	-7135.1
12+50	12+00	1022.2	-7077.3
12+00	12+00	972.2	-7078.4
12+00	12+00	972.2	-7078.4
11+50	12+00	922.2	-7079.5
11+00	12+00	872.2	-7080.6
10+50	12+00	822.2	-7081.7
10+00	12+00	772.2	-7082.9

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	12+00	722.2	-7084.0
9+00	12+00	672.2	-7085.1
12+50	12+50	1021.0	-7027.3
12+00	12+50	971.1	-7028.4
12+00	12+50	971.1	-7028.4
11+50	12+50	921.1	-7029.5
11+00	12+50	871.1	-7030.6
10+50	12+50	821.1	-7031.8
10+00	12+50	771.1	-7032.9
9+50	12+50	721.1	-7034.0
9+00	12+50	671.1	-7035.1
12+50	13+00	1019.9	-6977.3
12+00	13+00	969.9	-6978.4
12+00	13+00	969.9	-6978.4
11+50	13+00	920.0	-6979.5
11+00	13+00	870.0	-6980.7
10+50	13+00	820.0	-6981.8
10+00	13+00	770.0	-6982.9
9+50	13+00	720.0	-6984.0
9+00	13+00	670.0	-6985.1
12+50	13+50	1018.8	-6927.3
12+00	13+50	968.8	-6928.4
11+50	13+50	918.8	-6929.6
11+00	13+50	868.9	-6930.7
10+50	13+50	818.9	-6931.8
10+00	13+50	768.9	-6932.9
9+50	13+50	718.9	-6934.0
9+00	13+50	668.9	-6935.1
12+50	14+00	1017.7	-6877.3
12+00	14+00	967.7	-6878.5
11+50	14+00	917.7	-6879.6
11+00	14+00	867.7	-6880.7
10+50	14+00	817.8	-6881.8
10+00	14+00	767.8	-6882.9
9+50	14+00	717.8	-6884.0
9+00	14+00	667.8	-6885.1
12+50	14+50	1016.6	-6827.4
12+00	14+50	966.6	-6828.5
11+50	14+50	916.6	-6829.6
11+00	14+50	866.6	-6830.7
10+50	14+50	816.6	-6831.8

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+00	14+50	766.6	-6832.9
9+50	14+50	716.7	-6834.0
9+00	14+50	666.7	-6835.2
12+50	15+00	1015.5	-6777.4
12+00	15+00	965.5	-6778.5
11+50	15+00	915.5	-6779.6
11+00	15+00	865.5	-6780.7
10+50	15+00	815.5	-6781.8
10+00	15+00	765.5	-6782.9
9+50	15+00	715.5	-6784.1
9+00	15+00	665.6	-6785.2
12+50	15+50	1014.4	-6727.4
12+00	15+50	964.4	-6728.5
11+50	15+50	914.4	-6729.6
11+00	15+50	864.4	-6730.7
10+50	15+50	814.4	-6731.8
10+00	15+50	764.4	-6733.0
9+50	15+50	714.4	-6734.1
9+00	15+50	664.4	-6735.2
12+50	16+00	1013.2	-6677.4
12+00	16+00	963.3	-6678.5
11+50	16+00	913.3	-6679.6
11+00	16+00	863.3	-6680.7
10+50	16+00	813.3	-6681.9
10+00	16+00	763.3	-6683.0
9+50	16+00	713.3	-6684.1
9+00	16+00	663.3	-6685.2
12+50	16+50	1012.1	-6627.4
12+00	16+50	962.1	-6628.5
11+50	16+50	912.2	-6629.6
11+00	16+50	862.2	-6630.8
10+50	16+50	812.2	-6631.9
10+00	16+50	762.2	-6633.0
9+50	16+50	712.2	-6634.1
9+00	16+50	662.2	-6635.2
12+50	17+00	1011.0	-6577.4
12+00	17+00	961.0	-6578.5
11+50	17+00	911.0	-6579.6
11+00	17+00	861.0	-6580.8
10+50	17+00	811.1	-6581.9
10+50	17+00	811.1	-6581.9

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+00	17+00	761.1	–6583.0
9+50	17+00	711.1	–6584.1
9+00	17+00	661.1	–6585.2
12+50	17+50	1009.9	–6527.4
12+00	17+50	959.9	–6528.5
11+50	17+50	909.9	–6529.7
11+00	17+50	859.9	–6530.8
10+50	17+50	809.9	–6531.9
10+00	17+50	760.0	–6533.0
9+50	17+50	710.0	–6534.1
9+00	17+50	660.0	–6535.2
12+50	18+00	1008.8	–6477.4
12+00	18+00	958.8	–6478.6
11+50	18+00	908.8	–6479.7
11+00	18+00	858.8	–6480.8
10+50	18+00	808.8	–6481.9
10+00	18+00	758.8	–6483.0
9+50	18+00	708.9	–6484.1
9+00	18+00	658.9	–6485.2
12+50	18+50	1007.7	–6427.5
12+00	18+50	957.7	–6428.6
11+50	18+50	907.7	–6429.7
11+00	18+50	857.7	–6430.8
10+50	18+50	807.7	–6431.9
10+00	18+50	757.7	–6433.0
9+50	18+50	707.7	–6434.1
9+00	18+50	657.8	–6435.3
12+50	19+00	1006.5	–6377.5
12+00	19+00	956.6	–6378.6
11+50	19+00	906.6	–6379.7
11+00	19+00	856.6	–6380.8
10+50	19+00	806.6	–6381.9
10+00	19+00	756.6	–6383.0
9+50	19+00	706.6	–6384.2
9+00	19+00	656.6	–6385.3
12+50	19+50	1005.4	–6327.5
12+00	19+50	955.4	–6328.6
11+50	19+50	905.5	–6329.7
11+00	19+50	855.5	–6330.8
10+50	19+50	805.5	–6331.9
10+00	19+50	755.5	–6333.1

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	19+50	705.5	-6334.2
9+00	19+50	655.5	-6335.3
12+50	20+00	1004.3	-6277.5
12+00	20+00	954.3	-6278.6
11+50	20+00	904.3	-6279.7
11+00	20+00	854.4	-6280.8
10+50	20+00	804.4	-6282.0
10+00	20+00	754.4	-6283.1
9+50	20+00	704.4	-6284.2
9+00	20+00	654.4	-6285.3
12+50	20+50	1003.2	-6227.5
12+00	20+50	953.2	-6228.6
11+50	20+50	903.2	-6229.7
11+00	20+50	853.2	-6230.9
10+50	20+50	803.3	-6232.0
10+00	20+50	753.3	-6233.1
9+50	20+50	703.3	-6234.2
9+00	20+50	653.3	-6235.3
12+50	21+00	1002.1	-6177.5
12+00	21+00	952.1	-6178.6
11+50	21+00	902.1	-6179.8
11+00	21+00	852.1	-6180.9
10+50	21+00	802.1	-6182.0
10+00	21+00	752.2	-6183.1
9+50	21+00	702.2	-6184.2
9+00	21+00	652.2	-6185.3
12+50	21+50	1001.0	-6127.5
12+00	21+50	951.0	-6128.7
11+50	21+50	901.0	-6129.8
11+00	21+50	851.0	-6130.9
10+50	21+50	801.0	-6132.0
10+00	21+50	751.0	-6133.1
9+50	21+50	701.1	-6134.2
9+00	21+50	651.1	-6135.3

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
DITCH SOUTH OF WMUs 2 & 3

SAMPLE GRID	PLANT GRID	
	NORTH	EAST
00W	-1112.8	-5611.9
25W	-1113.3	-5636.9
50W	-1113.8	-5661.9
75W	-1113.9	-5686.9
100W	-1113.9	-5711.9
125W	-1113.9	-5736.9
150W	-1114.0	-5761.9
175W	-1114.0	-5786.9
200W	-1114.0	-5811.9
225W	-1114.0	-5836.9
250W	-1114.1	-5861.9
275W	-1114.1	-5886.9
300W	-1114.1	-5911.9
325W	-1114.2	-5936.9
350W	-1114.2	-5961.9
375W	-1114.2	-5986.9
400W	-1114.3	-6011.9
425W	-1114.3	-6036.9
450W	-1114.3	-6061.9
475W	-1114.3	-6086.9
500W	-1114.4	-6111.9
525W	-1114.4	-6136.9
550W	-1114.4	-6161.9
575W	-1114.5	-6186.9
600W	-1114.5	-6211.9
625W	-1114.5	-6236.9
650W	-1114.6	-6261.9
675W	-1114.6	-6286.9
700W	-1114.6	-6311.9
725W	-1114.7	-6336.9
750W	-1114.7	-6361.9
775W	-1114.6	-6386.9
800W	-1114.6	-6411.9
825W	-1114.6	-6436.9
850W	-1114.5	-6461.9
875W	-1114.5	-6486.9
900W	-1114.4	-6511.9
925W	-1114.4	-6536.9

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
DITCH SOUTH OF WMUs 2 & 3

SAMPLE GRID	PLANT GRID NORTH	PLANT GRID EAST
950W	–1114.3	–6561.9
975W	–1114.3	–6586.9
1000W	–1114.2	–6611.9
1025W	–1114.2	–6636.9
1050W	–1114.2	–6661.9
1075W	–1114.1	–6686.9
1100W	–1114.1	–6711.9
1125W	–1114.0	–6736.9
1150W	–1114.0	–6761.9
1175W	–1113.9	–6786.9
1200W	–1113.9	–6811.9
1225W	–1113.9	–6836.9
1250W	–1113.8	–6861.9
1275W	–1113.8	–6886.9
1300W	–1113.7	–6911.9
1325W	–1113.7	–6936.9
1350W	–1113.6	–6961.9
1375W	–1113.6	–6986.9
1400W	–1113.6	–7011.9
1425W	–1113.5	–7036.9
1450W	–1113.5	–7061.9
1475W	–1113.4	–7086.9
1500W	–1113.4	–7111.9
1525W	–1113.3	–7136.9
1550W	–1113.3	–7161.9
1575W	–1113.3	–7186.9
1600W	–1112.5	–7211.6
1620W	–1098.9	–7227.4
1625W	–1096.2	–7230.5
1650W	–1079.9	–7249.5
1675W	–1063.5	–7268.4

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
DITCH SOUTH OF WMU 7& 30
GAMMA WALKOVER SURVEY

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+00	10+00	676.7	-7285.0
9+00	10+50	675.6	-7235.0
9+00	11+00	674.5	-7185.1
9+00	11+50	673.4	-7135.1
9+00	12+00	672.2	-7085.1
9+00	12+50	671.1	-7035.1
9+00	13+00	670.0	-6985.1
9+00	13+50	668.9	-6935.1
9+00	14+00	667.8	-6885.1
9+00	14+50	666.7	-6835.2
9+00	15+00	665.6	-6785.2

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	10+00	–1767.4	–7058.2
10+00	10+00	–1717.4	–7058.8
10+30	10+03	–1687.3	–7056.2
10+45	10+00	–1672.4	–7059.3
10+50	10+00	–1667.4	–7059.4
8+75	10+25	–1842.1	–7032.3
9+25	10+25	–1792.1	–7032.9
9+75	10+25	–1742.1	–7033.5
10+25	10+25	–1692.1	–7034.1
10+27	10+17	–1690.2	–7042.1
10+30	10+19	–1687.1	–7040.2
10+32	10+25	–1685.1	–7034.2
10+35	10+30	–1682.0	–7029.2
10+47	10+22	–1670.1	–7037.4
8+00	10+50	–1916.7	–7006.3
8+50	10+50	–1866.7	–7006.9
9+00	10+50	–1816.7	–7007.6
9+50	10+50	–1766.8	–7008.2
10+00	10+50	–1716.8	–7008.8
10+33	10+40	–1683.9	–7019.2
10+50	10+50	–1666.8	–7009.4
8+25	10+75	–1891.4	–6981.6
8+75	10+75	–1841.4	–6982.3
9+25	10+75	–1791.4	–6982.9
9+75	10+75	–1741.4	–6983.5
10+25	10+75	–1691.4	–6984.1
10+44	10+70	–1672.5	–6989.3
8+00	11+00	–1916.1	–6956.3
8+50	11+00	–1866.1	–6956.9
9+00	11+00	–1816.1	–6957.6
9+50	11+00	–1766.1	–6958.2
10+00	11+00	–1716.1	–6958.8
10+50	11+00	–1666.1	–6959.4
8+25	11+25	–1890.8	–6931.6
8+75	11+25	–1840.8	–6932.3
9+25	11+25	–1790.8	–6932.9
9+75	11+25	–1740.8	–6933.5
10+25	11+25	–1690.8	–6934.1
8+00	11+50	–1915.5	–6906.3
8+50	11+50	–1865.5	–6906.9
9+00	11+50	–1815.5	–6907.6

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	11+50	-1765.5	-6908.2
10+00	11+50	-1715.5	-6908.8
10+30	11+60	-1685.4	-6899.2
10+50	11+50	-1665.5	-6909.4
8+25	11+75	-1890.2	-6881.6
8+75	11+75	-1840.2	-6882.3
9+25	11+75	-1790.2	-6882.9
9+75	11+75	-1740.2	-6883.5
10+25	11+75	-1690.2	-6884.1
10+35	11+70	-1680.3	-6889.2
10+35	11+75	-1680.2	-6884.2
10+35	11+77	-1680.2	-6882.2
8+00	12+00	-1914.9	-6856.3
8+50	12+00	-1864.9	-6856.9
9+00	12+00	-1814.9	-6857.6
9+50	12+00	-1764.9	-6858.2
10+00	12+00	-1714.9	-6858.8
10+35	11+90	-1680.0	-6869.2
10+35	11+98	-1679.9	-6861.2
10+34	12+00	-1680.9	-6859.2
10+50	12+00	-1664.9	-6859.4
8+25	12+25	-1889.6	-6831.6
8+75	12+25	-1839.6	-6832.3
9+25	12+25	-1789.6	-6832.9
9+75	12+25	-1739.6	-6833.5
10+25	12+25	-1689.6	-6834.1
10+34	12+23	-1680.6	-6836.2
10+36	12+25	-1678.6	-6834.2
10+50	12+25	-1664.6	-6834.4
8+00	12+50	-1914.3	-6806.3
8+50	12+50	-1864.3	-6807.0
9+00	12+50	-1814.3	-6807.6
9+50	12+50	-1764.3	-6808.2
9+79	12+47	-1735.3	-6811.5
10+00	12+50	-1714.3	-6808.8
10+36	12+45	-1678.4	-6814.2
10+34	12+47	-1680.3	-6812.2
10+34	12+50	-1680.3	-6809.2
10+50	12+50	-1664.3	-6809.4
10+48	12+47	-1666.3	-6812.4
8+25	12+75	-1889.0	-6781.6

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 G.M. MEASUREMENTS

SAMPLE GRID NORTH	SAMPLE GRID EAST	PLANT GRID NORTH	PLANT GRID EAST
8+75	21+75	-1827.9	-5882.3
9+25	12+75	-1789.0	-6782.9
9+56	12+70	-1758.0	-6788.3
9+75	12+75	-1739.0	-6783.5
10+25	12+75	-1689.0	-6784.1
10+36	12+65	-1678.1	-6794.2
10+42	12+65	-1672.1	-6794.3
10+48	12+69	-1666.1	-6790.4
8+00	13+00	-1913.7	-6756.3
8+50	13+00	-1863.7	-6757.0
9+00	13+00	-1813.7	-6757.6
9+50	13+00	-1763.7	-6758.2
9+64	13+09	-1749.6	-6749.4
9+64	13+14	-1749.5	-6744.4
10+00	13+00	-1713.7	-6758.8
10+50	13+00	-1663.7	-6759.4
8+25	13+25	-1888.4	-6731.6
8+75	13+25	-1838.4	-6732.3
9+25	13+25	-1788.4	-6732.9
9+75	13+25	-1738.4	-6733.5
10+25	13+38	-1688.2	-6721.1
10+50	13+50	-1663.1	-6709.4
8+00	13+50	-1913.1	-6706.3
8+50	13+50	-1863.1	-6707.0
9+00	13+50	-1813.1	-6707.6
9+50	13+50	-1763.1	-6708.2
10+00	13+50	-1713.1	-6708.8
10+50	13+50	-1663.1	-6709.4
8+25	13+75	-1887.7	-6681.6
8+75	13+75	-1837.8	-6682.3
9+25	13+75	-1787.8	-6682.9
9+75	13+75	-1737.8	-6683.5
10+25	13+75	-1687.8	-6684.1
8+50	14+00	-1862.4	-6657.0
9+00	14+00	-1812.4	-6657.6
9+50	14+00	-1762.4	-6658.2
10+00	14+00	-1712.4	-6658.8
10+50	14+00	-1662.4	-6659.4
8+75	14+25	-1837.1	-6632.3
10+50	12+50	-1664.3	-6809.4

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #1 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+25	14+25	-1787.1	-6632.9
9+75	14+25	-1737.1	-6633.5
10+25	14+25	-1687.1	-6634.1
8+50	14+50	-1861.8	-6607.0
9+00	14+50	-1811.8	-6607.6
9+50	14+50	-1761.8	-6608.2
10+00	14+50	-1711.8	-6608.8
10+50	14+50	-1661.8	-6609.4
8+75	14+75	-1836.5	-6582.3
9+25	14+75	-1786.5	-6582.9
9+75	14+75	-1736.5	-6583.5
9+25	14+75	-1786.5	-6582.9
9+00	15+00	-1811.2	-6557.6
9+50	15+00	-1761.2	-6558.2
10+00	15+00	-1711.2	-6558.8
10+25	15+03	-1686.2	-6556.1
10+50	15+00	-1661.2	-6559.4
9+25	15+25	-1785.9	-6532.9
9+75	15+25	-1735.9	-6533.5
10+25	15+25	-1685.9	-6534.1
10+45	9+85	-1672.6	-7074.3
10+33	9+86	-1684.5	-7073.2
10+51	12+68	-1663.1	-6791.4
10+51	14+14	-1661.3	-6645.4

LIMITS OF WMU1 SAMPLE AREA

8+00	10+50	-1916.7	-7006.3
9+00	10+00	-1811.2	-7058.2
10+50	10+00	-1667.4	-7059.4
10+50	15+50	-1660.6	-6509.4
9+00	15+50	-1810.6	-6507.6
8+00	13+50	-1913.1	-6706.3

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID NORTH	SAMPLE GRID EAST	PLANT GRID NORTH	PLANT GRID EAST
9+25	9+25	-1568.6	-6503.0
9+75	9+25	-1518.6	-6502.6
10+25	9+25	-1468.6	-6502.3
10+75	9+25	-1418.6	-6501.9
11+25	9+25	-1368.6	-6501.6
11+75	9+25	-1318.7	-6501.2
12+25	9+25	-1268.7	-6500.9
12+75	9+25	-1218.7	-6500.5
13+25	9+25	-1168.7	-6500.2
9+00	9+50	-1593.8	-6478.2
9+50	9+50	-1543.8	-6477.8
10+00	9+50	-1493.8	-6477.5
10+50	9+50	-1443.8	-6477.1
11+00	9+50	-1393.8	-6476.8
11+50	9+50	-1343.8	-6476.4
12+00	9+50	-1293.8	-6476.0
12+50	9+50	-1243.9	-6475.7
13+00	9+50	-1193.9	-6475.3
13+50	9+50	-1143.9	-6475.0
9+25	9+75	-1569.0	-6453.0
9+75	9+75	-1519.0	-6452.6
10+25	9+75	-1469.0	-6452.3
10+75	9+75	-1419.0	-6451.9
11+25	9+75	-1369.0	-6451.6
11+75	9+75	-1319.0	-6451.2
12+25	9+75	-1269.0	-6450.9
12+75	9+75	-1219.0	-6450.5
13+25	9+75	-1169.1	-6450.2
9+00	10+00	-1594.1	-6428.2
9+50	10+00	-1544.1	-6427.8
10+00	10+00	-1494.1	-6427.5
10+50	10+00	-1444.2	-6427.1
11+00	10+00	-1394.2	-6426.8
11+50	10+00	-1344.2	-6426.4
12+00	10+00	-1294.2	-6426.1
12+50	10+00	-1244.2	-6425.7
13+00	10+00	-1194.2	-6425.4
13+50	10+00	-1144.2	-6425.0
9+25	10+25	-1569.3	-6403.0
9+75	10+25	-1519.3	-6402.7
10+25	10+25	-1469.3	-6402.3

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+75	10+25	-1419.3	-6401.9
11+25	10+25	-1369.4	-6401.6
11+75	10+25	-1319.4	-6401.2
12+25	10+25	-1269.4	-6400.9
12+75	10+25	-1219.4	-6400.5
13+25	10+25	-1169.4	-6400.2
9+00	10+50	-1594.5	-6378.2
9+50	10+50	-1544.5	-6377.8
10+00	10+50	-1494.5	-6377.5
10+50	10+50	-1444.5	-6377.1
11+00	10+50	-1394.5	-6376.8
11+50	10+50	-1344.5	-6376.4
12+00	10+50	-1294.5	-6376.1
12+50	10+50	-1244.6	-6375.7
13+00	10+50	-1194.6	-6375.4
13+50	10+50	-1144.6	-6375.0
9+25	10+75	-1569.7	-6353.0
9+75	10+75	-1519.7	-6352.7
10+25	10+75	-1469.7	-6352.3
10+75	10+75	-1419.7	-6352.0
11+25	10+75	-1369.7	-6351.6
11+75	10+75	-1319.7	-6351.3
12+25	10+75	-1269.7	-6350.9
12+75	10+75	-1219.7	-6350.6
13+25	10+75	-1169.8	-6350.2
9+00	11+00	-1594.8	-6328.2
9+50	11+00	-1544.8	-6327.8
10+00	11+00	-1494.8	-6327.5
10+50	11+00	-1444.9	-6327.1
11+00	11+00	-1394.9	-6326.8
11+50	11+00	-1344.9	-6326.4
12+00	11+00	-1294.9	-6326.1
12+50	11+00	-1244.9	-6325.7
13+00	11+00	-1194.9	-6325.4
13+50	11+00	-1144.9	-6325.0
9+25	11+25	-1570.0	-6303.0
9+75	11+25	-1520.0	-6302.7
10+25	11+25	-1470.0	-6302.3
10+75	11+25	-1420.0	-6302.0
11+25	11+25	-1370.1	-6301.6
11+75	11+25	-1320.1	-6301.3

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+25	11+25	-1270.1	-6300.9
12+75	11+25	-1220.1	-6300.6
13+25	11+25	-1170.1	-6300.2
9+00	11+50	-1595.2	-6278.2
9+50	11+50	-1545.2	-6277.9
10+00	11+50	-1495.2	-6277.5
10+50	11+50	-1445.2	-6277.2
11+00	11+50	-1395.2	-6276.8
11+50	11+50	-1345.2	-6276.5
12+00	11+50	-1295.3	-6276.1
12+50	11+50	-1245.3	-6275.7
13+00	11+50	-1195.3	-6275.4
13+50	11+50	-1145.3	-6275.0
9+25	11+75	-1570.4	-6253.0
9+75	11+75	-1520.4	-6252.7
10+25	11+75	-1470.4	-6252.3
10+75	11+75	-1420.4	-6252.0
11+25	11+75	-1370.4	-6251.6
11+75	11+75	-1320.4	-6251.3
12+25	11+75	-1270.4	-6250.9
12+75	11+75	-1220.4	-6250.6
13+25	11+75	-1170.5	-6250.2
9+00	12+00	-1595.5	-6228.2
10+00	12+00	-1495.6	-6227.5
10+50	12+00	-1445.6	-6227.2
11+00	12+00	-1395.6	-6226.8
11+50	12+00	-1345.6	-6226.5
12+00	12+00	-1295.6	-6226.1
12+50	12+00	-1245.6	-6225.8
13+00	12+00	-1195.6	-6225.4
13+50	12+00	-1145.6	-6225.1
9+25	12+25	-1570.7	-6203.1
9+75	12+25	-1520.7	-6202.7
10+25	12+25	-1470.7	-6202.4
10+75	12+25	-1420.7	-6202.0
11+25	12+25	-1370.8	-6201.6
11+75	12+25	-1320.8	-6201.3
12+25	12+25	-1270.8	-6200.9
12+75	12+25	-1220.8	-6200.6
13+25	12+25	-1170.8	-6200.2
9+00	12+50	-1595.9	-6178.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	12+50	-1545.9	-6177.9
10+00	12+50	-1495.9	-6177.5
10+50	12+50	-1445.9	-6177.2
11+00	12+50	-1395.9	-6176.8
11+50	12+50	-1345.9	-6176.5
12+00	12+50	-1296.0	-6176.1
12+50	12+50	-1246.0	-6175.8
13+00	12+50	-1196.0	-6175.4
13+50	12+50	-1146.0	-6175.1
9+25	12+75	-1571.1	-6153.1
9+75	12+75	-1521.1	-6152.7
10+25	12+75	-1471.1	-6152.4
10+75	12+75	-1421.1	-6152.0
11+25	12+75	-1371.1	-6151.7
11+75	12+75	-1321.1	-6151.3
12+25	12+75	-1271.1	-6151.0
12+75	12+75	-1221.2	-6150.6
13+25	12+75	-1171.2	-6150.2
9+00	13+00	-1596.2	-6128.3
9+50	13+00	-1546.2	-6127.9
10+00	13+00	-1496.3	-6127.5
10+50	13+00	-1446.3	-6127.2
11+00	13+00	-1396.3	-6126.8
11+50	13+00	-1346.3	-6126.5
12+00	13+00	-1296.3	-6126.1
12+50	13+00	-1246.3	-6125.8
13+00	13+00	-1196.3	-6125.4
13+50	13+00	-1146.3	-6125.1
9+25	13+25	-1571.4	-6103.1
9+75	13+25	-1521.4	-6102.7
10+25	13+25	-1471.4	-6102.4
10+75	13+25	-1421.5	-6102.0
11+25	13+25	-1371.5	-6101.7
11+75	13+25	-1321.5	-6101.3
12+25	13+25	-1271.5	-6101.0
12+75	13+25	-1221.5	-6100.6
13+25	13+25	-1171.5	-6100.3
9+00	13+50	-1596.6	-6078.3
9+50	13+50	-1546.6	-6077.9
10+00	13+50	-1496.6	-6077.6
10+50	13+50	-1446.6	-6077.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
11+00	13+50	-1396.6	-6076.9
11+50	13+50	-1346.6	-6076.5
12+00	13+50	-1296.7	-6076.1
12+50	13+50	-1246.7	-6075.8
13+00	13+50	-1196.7	-6075.4
13+50	13+50	-1146.7	-6075.1
9+25	13+75	-1571.8	-6053.1
9+75	13+75	-1521.8	-6052.7
10+25	13+75	-1471.8	-6052.4
10+75	13+75	-1421.8	-6052.0
11+25	13+75	-1371.8	-6051.7
11+75	13+75	-1321.8	-6051.3
12+25	13+75	-1271.8	-6051.0
12+75	13+75	-1221.9	-6050.6
13+25	13+75	-1171.9	-6050.3
9+00	14+00	-1596.9	-6028.3
9+50	14+00	-1547.0	-6027.9
10+00	14+00	-1497.0	-6027.6
10+50	14+00	-1447.0	-6027.2
11+00	14+00	-1397.0	-6026.9
11+50	14+00	-1347.0	-6026.5
12+00	14+00	-1297.0	-6026.2
12+50	14+00	-1247.0	-6025.8
13+00	14+00	-1197.0	-6025.5
13+50	14+00	-1147.1	-6025.1
9+25	14+25	-1572.1	-6003.1
9+75	14+25	-1522.1	-6002.8
10+25	14+25	-1472.1	-6002.4
10+75	14+25	-1422.2	-6002.0
11+25	14+25	-1372.2	-6001.7
11+75	14+25	-1322.2	-6001.3
12+25	14+25	-1272.2	-6001.0
12+75	14+25	-1222.2	-6000.6
13+25	14+25	-1172.2	-6000.3
9+00	14+50	-1597.3	-5978.3
9+50	14+50	-1547.3	-5977.9
10+00	14+50	-1497.3	-5977.6
10+50	14+50	-1447.3	-5977.2
11+00	14+50	-1397.3	-5976.9
11+50	14+50	-1347.4	-5976.5
12+00	14+50	-1297.4	-5976.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+50	14+50	-1247.4	-5975.8
13+00	14+50	-1197.4	-5975.5
13+50	14+50	-1147.4	-5975.1
9+25	14+75	-1572.5	-5953.1
9+75	14+75	-1522.5	-5952.8
10+25	14+75	-1472.5	-5952.4
10+75	14+75	-1422.5	-5952.1
11+25	14+75	-1372.5	-5951.7
11+75	14+75	-1322.5	-5951.4
12+25	14+75	-1272.5	-5951.0
12+75	14+75	-1222.6	-5950.7
13+25	14+75	-1172.6	-5950.3
9+00	15+00	-1597.6	-5928.3
9+50	15+00	-1547.7	-5927.9
10+00	15+00	-1497.7	-5927.6
10+50	15+00	-1447.7	-5927.2
11+00	15+00	-1397.7	-5926.9
11+50	15+00	-1347.7	-5926.5
12+00	15+00	-1297.7	-5926.2
12+50	15+00	-1247.7	-5925.8
13+00	15+00	-1197.7	-5925.5
13+50	15+00	-1147.8	-5925.1
9+25	15+25	-1572.8	-5903.1
9+75	15+25	-1522.8	-5902.8
10+25	15+25	-1472.9	-5902.4
10+75	15+25	-1422.9	-5902.1
11+25	15+25	-1372.9	-5901.7
11+75	15+25	-1322.9	-5901.4
12+25	15+25	-1272.9	-5901.0
12+75	15+25	-1222.9	-5900.7
13+25	15+25	-1172.9	-5900.3
13+40	9+75	-1154.1	-6450.1
13+40	10+25	-1154.4	-6400.1
13+40	10+75	-1154.8	-6350.1
13+40	11+25	-1155.1	-6300.1
13+40	11+75	-1155.5	-6250.1
13+40	12+25	-1155.8	-6200.1
13+40	12+75	-1156.2	-6150.1
13+40	13+25	-1156.5	-6100.2
13+40	13+75	-1156.9	-6050.2
13+40	14+25	-1157.2	-6000.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #4 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
13+40	14+75	-1157.6	-5950.2

LIMITS OF WMU4 SAMPLE AREA

13+50	15+50	-1148.1	-5875.1
8+75	15+50	-1623.0	-5878.5
8+75	9+00	-1618.4	-6528.3
13+50	9+00	-1143.5	-6525.0
8+92	9+60	-1601.8	-6468.2

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+67	10+50	741.5	-7233.6
9+67	11+00	741.5	-7183.6
9+67	11+25	740.9	-7158.6
9+67	11+50	740.3	-7133.6
9+67	11+75	739.8	-7108.6
9+67	12+00	739.2	-7083.6
9+67	12+25	738.7	-7058.6
9+67	12+50	738.1	-7033.6
9+67	12+75	737.6	-7008.6
9+67	13+00	737.0	-6983.6
9+67	13+25	736.4	-6958.6
9+67	13+50	735.9	-6933.6
9+67	13+75	735.3	-6908.6
9+67	14+00	734.8	-6883.6
9+67	14+25	734.2	-6858.7
9+67	14+50	733.7	-6833.7
9+67	14+75	733.1	-6808.7
9+67	15+00	732.5	-6783.7
9+67	15+25	732.0	-6758.7
9+67	15+50	731.4	-6733.7
9+67	15+75	730.9	-6708.7
9+67	16+00	730.3	-6683.7
9+67	16+25	729.8	-6658.7
9+67	16+50	729.2	-6633.7
9+67	16+75	728.6	-6608.7
9+67	17+00	728.1	-6583.7
9+67	17+25	727.5	-6558.7
9+67	17+50	727.0	-6533.7
9+67	17+75	726.4	-6508.7
9+67	18+00	725.9	-6483.8
9+67	18+25	725.3	-6458.8
9+67	18+50	724.7	-6433.8
9+67	18+75	724.2	-6408.8
9+67	19+00	723.6	-6383.8
9+67	19+25	723.1	-6358.8
9+67	19+50	722.5	-6333.8
9+67	19+75	722.0	-6308.8
9+67	20+00	721.4	-6283.8
9+67	20+25	720.8	-6258.8
9+67	20+50	720.3	-6233.8
9+67	20+75	719.7	-6208.8

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+67	21+00	719.2	-6183.8
9+67	21+25	718.6	-6158.8
9+67	21+50	718.1	-6133.8
9+67	10+50	742.6	-7233.6
9+75	10+25	751.1	-7258.4
10+25	10+25	801.1	-7257.3
10+75	10+25	851.1	-7256.1
11+25	10+25	901.1	-7255.0
11+75	10+25	951.1	-7253.9
9+50	10+50	725.6	-7233.9
10+00	10+50	775.6	-7232.8
10+50	10+50	825.6	-7231.7
11+00	10+50	875.5	-7230.6
11+50	10+50	925.5	-7229.5
12+00	10+50	975.5	-7228.4
9+75	10+75	750.0	-7208.4
10+25	10+75	800.0	-7207.3
10+53	10+78	827.9	-7203.6
10+75	10+75	850.0	-7206.2
11+25	10+75	900.0	-7205.0
11+75	10+75	950.0	-7203.9
12+25	10+75	999.9	-7202.8
9+50	11+00	724.5	-7183.9
9+94	10+92	768.6	-7191.0
10+00	11+00	774.5	-7182.8
10+50	11+00	824.4	-7181.7
11+00	11+00	874.4	-7180.6
11+50	11+00	924.4	-7179.5
12+00	11+00	974.4	-7178.4
9+72	11+12	746.2	-7171.5
9+75	11+25	748.9	-7158.4
10+25	11+25	798.9	-7157.3
10+75	11+25	848.9	-7156.2
11+25	11+25	898.9	-7155.1
11+75	11+25	948.8	-7153.9
12+25	11+25	998.8	-7152.8
9+50	11+50	723.4	-7134.0
10+00	11+50	773.3	-7132.8
10+50	11+50	823.3	-7131.7
11+00	11+50	873.3	-7130.6
11+50	11+50	923.3	-7129.5

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+00	11+50	973.3	–7128.4
9+75	11+75	747.8	–7108.4
10+25	11+75	797.8	–7107.3
10+75	11+75	847.8	–7106.2
11+25	11+75	897.7	–7105.1
11+75	11+75	947.7	–7104.0
12+25	11+75	997.7	–7102.8
9+50	12+00	722.2	–7084.0
10+00	12+00	772.2	–7082.9
10+09	11+97	781.3	–7085.7
10+06	12+05	778.1	–7077.7
10+50	12+00	822.2	–7081.7
11+00	12+00	872.2	–7080.6
11+50	12+00	922.2	–7079.5
12+00	12+00	972.2	–7078.4
9+75	12+25	746.7	–7058.4
10+25	12+25	796.7	–7057.3
10+75	12+25	846.6	–7056.2
11+04	12+18	875.8	–7062.5
11+25	12+25	896.6	–7055.1
11+75	12+25	946.6	–7054.0
12+25	12+25	996.6	–7052.9
9+50	12+50	721.1	–7034.0
10+00	12+50	771.1	–7032.9
10+50	12+50	821.1	–7031.8
11+00	12+50	871.1	–7030.6
11+50	12+50	921.1	–7029.5
12+00	12+50	971.1	–7028.4
9+75	12+75	745.6	–7008.4
9+98	12+78	768.5	–7004.9
10+25	12+75	795.5	–7007.3
10+75	12+75	845.5	–7006.2
11+25	12+75	895.5	–7005.1
11+75	12+75	945.5	–7004.0
12+25	12+75	995.5	–7002.9
9+50	13+00	720.0	–6984.0
9+70	13+08	739.8	–6975.6
10+00	13+00	770.0	–6982.9
10+50	13+00	820.0	–6981.8
11+00	13+00	870.0	–6980.7
11+50	13+00	920.0	–6979.5

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+00	13+00	969.9	-6978.4
9+75	13+25	744.4	-6958.5
10+25	13+25	794.4	-6957.3
10+75	13+25	844.4	-6956.2
11+25	13+25	894.4	-6955.1
11+75	13+25	944.4	-6954.0
12+04	13+25	973.4	-6953.3
12+25	13+25	994.4	-6952.9
9+50	13+50	718.9	-6934.0
10+00	13+50	768.9	-6932.9
10+50	13+50	818.9	-6931.8
11+00	13+50	868.9	-6930.7
11+50	13+50	918.8	-6929.6
12+00	13+50	968.8	-6928.4
9+75	13+75	743.3	-6908.5
9+87	13+85	755.1	-6898.2
10+25	13+75	793.3	-6907.3
10+34	13+75	802.3	-6907.1
10+75	13+75	843.3	-6906.2
11+25	13+75	893.3	-6905.1
11+75	13+75	943.3	-6904.0
12+25	13+75	993.3	-6902.9
9+50	14+00	717.8	-6884.0
9+80	14+05	747.7	-6878.4
10+00	14+00	767.8	-6882.9
10+50	14+00	817.8	-6881.8
11+00	14+00	867.7	-6880.7
11+50	14+00	917.7	-6879.6
12+00	14+00	967.7	-6878.5
9+75	14+25	742.2	-6858.5
10+25	14+25	792.2	-6857.4
10+40	14+40	806.9	-6842.0
10+75	14+25	842.2	-6856.2
11+25	14+25	892.2	-6855.1
11+38	14+42	904.8	-6837.8
11+75	14+25	942.2	-6854.0
11+75	14+50	941.6	-6829.0
12+25	14+25	992.1	-6852.9
9+50	14+50	716.7	-6834.0
9+91	14+52	757.6	-6831.1
10+00	14+50	766.6	-6832.9

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+50	14+50	816.6	-6831.8
10+57	14+50	823.6	-6831.7
11+00	14+50	866.6	-6830.7
11+50	14+50	916.6	-6829.6
12+00	14+50	966.6	-6828.5
9+75	14+75	741.1	-6808.5
10+25	14+75	791.1	-6807.4
10+75	14+75	841.1	-6806.3
10+99	14+69	865.2	-6811.7
11+25	14+75	891.1	-6805.1
11+48	14+85	913.8	-6794.6
11+75	14+75	941.0	-6804.0
12+01	14+74	967.1	-6804.5
12+25	14+75	991.0	-6802.9
9+50	15+00	715.5	-6784.1
10+00	15+00	765.5	-6782.9
10+19	14+95	784.6	-6787.5
10+50	15+00	815.5	-6781.8
11+00	15+00	865.5	-6780.7
11+50	15+00	915.5	-6779.6
12+00	15+00	965.5	-6778.5
11+75	15+01	940.5	-6778.0
9+75	15+25	740.0	-6758.5
9+90	15+35	754.8	-6748.2
10+25	15+25	790.0	-6757.4
10+50	15+30	814.9	-6751.8
10+58	15+25	823.0	-6756.7
10+75	15+25	840.0	-6756.3
11+25	15+25	889.9	-6755.2
11+37	15+19	902.1	-6760.9
11+75	15+25	939.9	-6754.0
12+04	15+10	969.3	-6768.4
12+25	15+25	989.9	-6752.9
9+50	15+50	714.4	-6734.1
10+00	15+50	764.4	-6733.0
10+50	15+50	814.4	-6731.8
11+00	15+50	864.4	-6730.7
11+50	15+50	914.4	-6729.6
12+00	15+50	964.4	-6728.5
9+75	15+75	738.9	-6708.5
10+25	15+75	788.9	-6707.4

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+76	15+85	839.6	-6696.3
10+59	15+65	823.1	-6716.6
10+75	15+75	838.8	-6706.3
11+25	15+75	888.8	-6705.2
11+75	15+75	938.8	-6704.1
12+25	15+75	988.8	-6702.9
9+50	16+00	713.3	-6684.1
9+75	15+99	740.0	-6685.1
10+00	16+00	763.3	-6683.0
10+50	16+00	813.3	-6681.9
11+00	16+00	863.3	-6680.7
11+47	15+90	910.5	-6689.7
11+50	16+00	913.3	-6679.6
11+62	15+92	925.4	-6687.4
12+00	16+00	963.3	-6678.5
9+75	16+25	737.8	-6658.5
9+85	16+48	747.2	-6635.3
10+25	16+25	787.7	-6657.4
10+37	16+44	799.3	-6638.2
10+68	16+49	830.2	-6632.5
10+75	16+25	837.7	-6656.3
11+25	16+25	887.7	-6655.2
11+75	16+25	937.7	-6654.1
11+75	16+42	937.7	-6638.2
12+25	16+25	987.7	-6653.0
9+50	16+50	712.2	-6634.1
10+00	16+50	762.2	-6633.0
10+47	16+60	809.0	-6621.9
10+50	16+50	812.2	-6631.9
10+98	16+68	859.8	-6612.8
11+00	16+50	862.2	-6630.8
11+50	16+50	912.2	-6629.6
12+00	16+50	962.1	-6628.5
9+75	16+73	736.7	-6610.5
9+75	16+75	736.6	-6608.5
10+25	16+75	786.6	-6607.4
10+75	16+75	836.6	-6606.3
11+30	16+70	891.7	-6610.1
11+25	16+75	886.6	-6605.2
11+65	16+76	926.6	-6603.3
11+75	16+75	936.6	-6604.1

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+01	16+75	962.6	-6603.5
12+25	16+75	986.6	-6603.0
9+50	17+00	711.1	-6584.1
10+00	17+00	761.1	-6583.0
10+18	17+18	778.7	-6564.6
10+50	17+00	811.1	-6581.9
10+62	17+08	822.9	-6573.6
11+00	17+00	861.0	-6580.8
11+47	17+02	908.0	-6577.7
11+50	17+00	911.0	-6579.6
12+00	17+00	961.0	-6578.5
9+75	17+25	735.5	-6558.6
9+85	17+35	745.3	-6548.3
10+25	17+25	785.5	-6557.4
10+75	17+25	835.5	-6556.3
11+25	17+25	885.5	-6555.2
11+54	17+49	913.9	-6530.6
11+75	17+25	935.5	-6554.1
12+25	17+25	985.5	-6553.0
12+38	17+45	998.0	-6532.7
9+50	17+50	710.0	-6534.1
9+77	17+51	736.9	-6532.5
10+00	17+50	760.0	-6533.0
10+30	17+56	789.8	-6526.3
10+50	17+50	809.9	-6531.9
11+00	17+56	859.8	-6524.8
11+00	17+50	859.9	-6530.8
11+41	17+65	900.6	-6514.9
11+50	17+50	909.9	-6529.7
11+51	17+70	910.5	-6509.6
12+00	17+50	959.9	-6528.5
12+00	17+99	958.8	-6479.6
9+75	17+75	734.4	-6508.6
10+25	17+75	784.4	-6507.5
10+75	17+75	834.4	-6506.3
11+25	17+75	884.4	-6505.2
11+75	17+75	934.4	-6504.1
12+25	17+75	984.3	-6503.0
9+50	18+00	708.9	-6484.1
9+85	18+20	743.4	-6463.4
10+00	18+00	758.8	-6483.0

ATTACHMENT 3–D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+49	18+35	807.1	–6446.9
10+50	18+00	808.8	–6481.9
10+75	18+35	833.0	–6446.4
11+00	18+00	858.8	–6480.8
11+45	18+15	903.5	–6464.8
11+50	18+00	908.8	–6479.7
11+75	18+15	933.5	–6464.1
12+00	18+00	958.8	–6478.6
12+02	18+49	959.7	–6429.5
9+75	18+25	733.3	–6458.6
10+25	18+25	783.3	–6457.5
10+75	18+25	833.3	–6456.4
11+25	18+25	883.3	–6455.2
11+75	18+25	933.2	–6454.1
12+25	18+25	983.2	–6453.0
9+50	18+50	707.7	–6434.1
9+75	18+63	732.4	–6420.6
10+00	18+50	757.7	–6433.0
10+50	18+50	807.7	–6431.9
10+75	18+80	832.0	–6401.4
11+00	18+50	857.7	–6430.8
11+49	18+62	906.4	–6417.7
11+50	18+50	907.7	–6429.7
11+98	18+80	955.0	–6398.6
12+00	18+50	957.7	–6428.6
12+05	18+75	962.1	–6403.5
9+75	18+75	732.2	–6408.6
10+25	18+75	782.2	–6407.5
10+75	18+75	832.2	–6406.4
11+25	18+75	882.1	–6405.3
11+75	18+75	932.1	–6404.1
12+25	18+75	982.1	–6403.0
9+50	19+00	706.6	–6384.2
10+00	19+00	756.6	–6383.0
10+50	19+00	806.6	–6381.9
10+85	19+25	841.0	–6356.2
11+00	19+00	856.6	–6380.8
11+15	19+25	871.0	–6355.5
11+50	19+00	906.6	–6379.7
11+65	19+10	921.3	–6369.4
12+00	19+00	956.6	–6378.6

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+04	19+12	960.3	-6366.5
9+75	19+25	731.1	-6358.6
10+25	19+25	781.1	-6357.5
10+75	19+25	831.0	-6356.4
11+25	19+25	881.0	-6355.3
11+75	19+25	931.0	-6354.2
12+25	19+25	981.0	-6353.0
9+50	19+50	705.5	-6334.2
10+00	19+50	755.5	-6333.1
10+50	19+50	805.5	-6331.9
11+00	19+50	855.5	-6330.8
11+48	19+85	902.7	-6294.8
11+50	19+50	905.5	-6329.7
11+70	19+55	925.3	-6324.3
12+00	19+50	955.4	-6328.6
9+75	19+75	730.0	-6308.6
10+25	19+75	779.9	-6307.5
10+75	19+75	829.9	-6306.4
11+25	19+75	879.9	-6305.3
11+75	19+75	929.9	-6304.2
12+25	19+75	979.9	-6303.1
9+50	20+00	704.4	-6284.2
10+00	20+00	754.4	-6283.1
10+50	20+00	804.4	-6282.0
11+00	20+00	854.4	-6280.8
11+20	20+25	873.8	-6255.4
11+50	20+00	904.3	-6279.7
11+70	20+15	924.0	-6264.3
12+00	20+00	953.2	-6035.6
12+02	20+47	955.3	-6231.6
9+75	20+25	728.8	-6258.6
10+25	20+25	778.8	-6257.5
10+75	20+25	828.8	-6256.4
11+25	20+25	878.8	-6255.3
11+75	20+25	928.8	-6254.2
12+25	20+25	978.8	-6253.1
9+50	20+50	703.3	-6234.2
10+00	20+50	753.3	-6233.1
10+50	20+50	803.3	-6232.0
11+00	20+50	853.2	-6230.9

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
11+45	20+99	897.1	-6180.9
11+50	20+50	903.2	-6229.7
11+92	20+52	945.2	-6226.8
12+00	20+50	953.2	-6228.6
9+75	20+75	727.7	-6208.7
10+25	20+75	777.7	-6207.5
10+75	20+75	827.7	-6206.4
11+25	20+75	877.7	-6205.3
11+75	20+75	927.7	-6204.2
12+25	20+75	977.7	-6203.1
9+50	21+00	702.2	-6184.2
10+00	21+00	752.2	-6183.1
10+49	21+01	801.1	-6181.0
10+50	21+00	802.1	-6182.0
10+59	21+00	811.1	-6181.8
11+00	21+00	852.1	-6180.9
11+50	21+00	902.1	-6179.8
12+00	21+00	952.1	-6178.6
12+01	20+95	953.2	-6183.6
9+75	21+25	726.6	-6158.7
10+25	21+25	776.6	-6157.5
10+75	21+25	826.6	-6156.4
11+25	21+25	876.6	-6155.3
11+75	21+25	926.6	-6154.2
12+25	21+25	976.5	-6153.1
9+50	21+50	701.1	-6134.2
10+00	21+50	751.0	-6133.1
10+50	21+50	801.0	-6132.0
11+00	21+50	851.0	-6130.9
11+30	21+51	881.0	-6129.2
11+49	21+48	900.0	-6131.8
11+50	21+50	901.0	-6129.8
11+70	21+45	921.1	-6134.3
11+90	21+51	941.0	-6127.9
12+00	21+50	951.0	-6128.7
12+02	21+53	952.9	-6125.6
12+15	21+46	966.1	-6132.3

LIMITS OF WMU7&30 SAMPLE AREA

12+25	10+25	1001.1	-7252.8

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
12+25	12+75	995.5	-7002.9
9+25	12+75	695.6	-7009.6
9+25	10+25	701.1	-7259.5

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #91 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+50	6+00	-1076.8	-7206.9
10+00	6+00	-1026.8	-7206.4
10+50	6+00	-976.8	-7206.0
9+75	6+25	-1052.0	-7181.6
10+25	6+25	-1002.0	-7181.2
9+50	6+50	-1077.3	-7156.8
10+00	6+50	-1027.3	-7156.4
10+50	6+50	-977.2	-7155.9
9+75	6+75	-1052.5	-7131.6
10+25	6+75	-1002.5	-7131.1
9+50	7+00	-1077.7	-7106.8
10+00	7+00	-1027.7	-7106.4
10+50	7+00	-977.7	-7105.9
9+75	7+25	-1053.0	-7081.6
10+25	7+25	-1002.9	-7081.1
9+50	7+50	-1078.2	-7056.8
10+00	7+50	-1028.2	-7056.3
10+50	7+50	-978.2	-7055.9
9+75	7+75	-1053.4	-7031.6
10+25	7+75	-1003.4	-7031.1
9+50	8+00	-1078.7	-7006.8
10+00	8+00	-1028.6	-7006.3
10+50	8+00	-978.6	-7005.9
9+75	8+25	-1053.9	-6981.5
10+25	8+25	-1003.9	-6981.1
9+50	8+50	-1079.1	-6956.8
10+00	8+50	-1029.1	-6956.3
10+50	8+50	-979.1	-6955.8
9+75	8+75	-1054.3	-6931.5
10+25	8+75	-1004.3	-6931.1
9+50	9+00	-1079.6	-6906.7
10+00	9+00	-1029.6	-6906.3
10+50	9+00	-979.5	-6905.8
9+75	9+25	-1054.8	-6881.5
10+25	9+25	-1004.8	-6881.0
9+50	9+50	-1080.0	-6856.7
10+00	9+50	-1030.0	-6856.3
10+50	9+50	-980.0	-6855.8
9+75	9+75	-1055.3	-6831.5
10+25	9+75	-1005.2	-6831.0
9+50	10+00	-1080.5	-6806.7

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
WMU #91 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
10+00	10+00	-1030.5	-6806.2
10+50	10+00	-980.4	-6805.8
9+75	10+25	-1055.7	-6781.4
10+25	10+25	-1005.7	-6781.0
9+50	10+50	-1080.9	-6756.7
10+00	10+50	-1030.9	-6756.2
10+50	10+50	-980.9	-6755.7

LIMITS OF WMU #91 SAMPLE AREA

9+50	6+00	-1076.8	-7206.9
10+50	6+00	-976.8	-7206.0
10+50	10+50	-980.9	-6755.7
9+50	10+50	-1080.9	-6756.7

ATTACHMENT 3-D
COORDINATE SYSTEM INTERCOMPARISON
DITCH SOUTH OF WMU 7&30 G.M. MEASUREMENTS

SAMPLE GRID		PLANT GRID	
NORTH	EAST	NORTH	EAST
9+15	10+50	690.6	-7234.7
9+15	10+75	690.0	-7209.7
9+15	11+00	689.5	-7184.7
9+15	11+25	688.9	-7159.7
9+15	11+50	688.4	-7134.7
9+15	11+75	687.8	-7109.7
9+15	12+00	687.2	-7084.8
9+15	12+25	686.7	-7059.8
9+15	12+50	686.1	-7034.8
9+15	12+75	685.6	-7009.8
9+15	13+00	685.0	-6984.8
9+15	13+25	684.5	-6959.8
9+15	13+50	683.9	-6934.8
9+15	13+75	683.3	-6909.8
9+15	14+00	682.8	-6884.8
9+15	14+25	682.2	-6859.8
9+15	14+50	681.7	-6834.8
9+15	14+75	681.1	-6809.8
9+15	15+00	680.6	-6784.8
9+15	15+10	680.3	-6774.8

APPENDIX 2B-4

Well Installation, Development, and Soil Sampling: Stage A Monitoring Wells MW-155 through MW-190

TECHNICAL MEMORANDUM NO. 4
PGDP PHASE II SITE INVESTIGATION

PREPARED BY: Kim Ries/SFO

SUBJECT: Well Installation, Development, and Soil Sampling: Stage A Monitoring Wells, MW-155 through MW-190

PROJECT: ORO30888.FI

INTRODUCTION

PURPOSE AND SCOPE

This TM documents the installation of Stage A monitoring wells for the Phase II Site Investigation at the PGDP. This memorandum presents the background and rationale for the Stage A monitoring well program well construction and lithologic data, and the lithologic results of the drilling program. It also to discusses well locations and describes methodologies for drilling, borehole logging, well installation, and well development; equipment decontamination procedures; and the management of wastes derived from this task; and to present.

BACKGROUND

This monitoring well installation program augments an ongoing DOE/Energy Systems Environmental Restoration Program (ERP) to meet three objectives of an EPA and DOE Consent Order: (1) to determine the nature and extent and threat of offsite groundwater contamination caused by sources at the PGDP; (2) investigate effects of contaminant releases and take appropriate response action to protect public health and the environment; and (3) to develop a work plan and schedule for implementing response actions. The ERP investigation is being conducted in two phases.

Phase I, which has been completed, focused on evaluating the nature and extent of off-site contamination originating at the PGDP. Results indicate that Tc-99 and trichloroethylene (TCE) compounds were detected in the deep groundwater system, that TCE and Tc-99 concentrations were variable, but indicate plume(s) migrating offsite in the Regional Gravel Aquifer (RGA), and that variable contaminants were detected in the shallow groundwater system offsite adjacent to streams. No shallow contaminant plumes were identified in Phase I.

Phase II of the PGDP site investigation is being carried out in two stages. The objective for Phase II, Stage A, is to characterize onsite sources of contamination at the PGDP. To this end, 35 monitoring wells were installed onsite and adjacent to identified WMUs. Data collected during the well installation include lithologic logs and field instrument screens for radiologic VOCs from soil samples. These data are presented herein. Data resulting from the well installation task will include laboratory chemical analysis of soil and groundwater samples collected from well boreholes and the developed monitoring wells, respectively. These data will be discussed in the Phase II Site Investigation Report.

Phase II, Stage A wells were installed in two target aquifers: the shallow groundwater system, which is contained within sands of the Upper Continental Deposits and the RGA, which consists of sands and gravels designated as the Lower Continental Deposits. These aquifer zones would most likely be affected by onsite releases from WMUs and, therefore provide data to define the sources of offsite contaminants (Objective 1 of the Consent Order).

RESULTS

The Stage A well borehole lithologic logs generally correlate with borehole lithologic logs collected during the Phase I Site Investigation (December 1990) and with previous borings/wells at the plant. In general, the onsite stratigraphy consists of 0 to 6 feet of fill underlain by approximately 15 to 25 feet of lean clay, underlain by alternating layers of sands (typically less than 5-feet thick) and (40 MW-181) to 60 feet (MW-188) of clayey sands or sandy clays. These first 50 to 75 feet of deposits contain the shallow groundwater system within the relatively permeable sands and occasional gravels of the Upper Continental Deposits. Nineteen monitoring wells were installed within the shallow groundwater system.

Typically, (except for MW-165 and MW-173, where sands were not logged; Figure 4-1) there are approximately from 2 to 35 feet of loose sands directly above the RGA. These sands seem to be in hydraulic connection with the RGA, although, they were considered part of the Upper Continental Deposits for the Phase I report. Because these sands were loose and wet, their occurrence was often marked by little to no sample recovery. Installing wells in areas where there were over 20 feet of these sands (MW-161, MW-163, and MW-175) was difficult. Sands rose in the augers, requiring the driller to attempt redrilling or to fill the augers with water to keep pressure on the sands.

The RGA, readily identified by loose sands and gravels, was encountered consistently at depths between approximately 50 (MW-173) and 80 (MW-161) feet below ground surface (bgs). One exception was at MW-184 (Figure 4-1), which is located on a subterranean terrace feature, where lean clays were encountered from 15 feet bgs to the anticipated depth of the RGA, at 70 feet bgs. Here, only a shallow well, MW-184, was installed and the borehole for MW-183 was grouted from total depth to ground surface.

The base of the gravel aquifer was established at three locations during this drilling program: MW-155, MW-158, and soil boring H-219 (Locations 1, 2, and 13;

Figure 4-1). At these locations, the gravel aquifer thickness ranged from 25 (MW-155, H-219) to 50 feet (MW-158). It was underlain by a fine-grained sand at MW-158 (western edge of site), a sandy lean clay at MW-155 (C-400 Building), and a lean clay at H-219 (active landfill, north of the plant). Fourteen monitoring wells were installed within the upper part and two wells were installed in the lower part of the gravel aquifer. Wells installed in the gravel aquifer were constructed with isolation casings to hydraulically seal shallow permeable zones from the deeper RGA, minimizing the possibility of a conduit carrying contaminants from the shallow groundwater system to the gravel aquifer.

Monitoring wells were installed in groupings or clusters, and wells were designed based on information collected during lithologic logging of the deepest borehole at each well group location. Wells were installed using truck-mounted CME drill rigs operated by Brotcke Engineering Company, Inc. (St. Louis, Missouri). During borehole drilling and monitoring well installation, a hydrogeologist/geotechnical engineer from CH2M HILL and an industrial hygiene/health physics (IH/HP) technician from TMA/Eberline were present and provided technical supervision and health and safety monitoring. Other field and office personnel assisted in the acquisition of samples and supplies and management of task derived wastes. Field information for each well group, including personnel present, installation dates, development dates, and drill rigs and equipment used is included in Attachment 4-A.

WELL LOCATIONS

Monitoring well locations are shown on Figure 4-1. Well locations were selected that would provide information regarding subsurface hydrogeologic conditions and would provide data relevant to a specific WMU's contribution to offsite contamination. Table 4-1 lists the well locations, well numbers, coordinates, top of casing elevation, hydrostratigraphic unit, screened interval (feet bgs), and reason(s) for the location.

The 2-inch-diameter stainless steel wells were designed to allow groundwater sampling and slug testing, while minimizing the volume of waste soils and purgewater generated. Wells were installed in the following two hydrostratigraphic units:

- The uppermost saturated zone in the Upper Continental Deposits. This zone is sometimes referred to as the shallow groundwater system. Although this zone appears to be confined to semiconfined beneath approximately 15 to 25 feet of clay at site borehole locations, it is expected to be the first water-producing zone to receive contaminants released from a possible source.

- The RGA. This aquifer is a pathway for offsite groundwater contaminant transport. Site lithologic logs and downward vertical gradients suggest that the RGA may not be hydraulically isolated from the shallow aquifer. Wells were installed in both the upper and lower 7 feet of the RGA.

Table 4-1
Stage A Monitoring Well Location Data
PGDP Phase II Site Investigation

Well Group Number	Well Group Location	Well No.	Plant Grid Coordinates N	Plant Grid Coordinates E	Top of 2" casing Elevation (ft msl)	Hydrogeologic Unit	Screened Interval (ft bgs)	Reasons for Well Locations
1	WMU 11 - TCE Leak Site	MW-155 MW-156 MW-157	S1669 S1704 S1689	W4025 W4026 W4026	381.25 382.06 381.56	Lower RGA[a] Upper RGA Shallow gs[b]	87 - 92 63 - 70 30 - 35	Reported TCE leak in adjacent drain
2	WMU 91- Cylinder Drop Test Area	MW-158 MW-159 MW-160	S0991 S0990 S0972	W6957 W6937 W6946	367[c] 367[c] 367[c]	Lower RGA Upper RGA Shallow gs	102 - 108 63 - 68 20 - 25	TCE detected in Phase I soil boring to 36'
3	WMU 1- North Oil Landfarm	MW-161 MW-161A MW-162	 S1667 S1667	 W6917 W6886	 373.55 374.17	Upper RGA[d] Upper RGA Shallow gs	65 - 70 78 - 83 18 - 24	Check for TCE in groundwater, since TCE in Phase I soil boring at 32'
4	Eastern part of Plant	MW-163 MW-164	S1401 S1416	W2041 W2043	386.14 386.29	Upper RGA Shallow gs	94 - 99 42 - 47	Monitoring point for contaminants moving to East (i.e., from C-400 building)
5	Northern part of plant	MW-165 MW-166	N0898 N0893	W3136 W3152	379.74 380.07	Upper RGA Shallow gs	63 - 68 33 - 38	Monitoring point for contaminants moving to NE (i.e., from C-400 building)
6	AREA A- Diesel Spill	MW-167 MW-168	S0909 S0925	W4822 W4822	376.36 377.42	Shallow gs Upper RGA	21 - 26 63 - 68	Monitoring point downgradient from the diesel spill
7	WMU 2 and 3- Downgradient	MW-169 MW-170	S0191 S0176	W5558 W5558	373.41 373.98	Upper RGA Shallow gs	65 - 70 25 - 30	Evaluate water quality downgradient from WMU 2 and3

Table 4-1
Stage A Monitoring Well Location Data
PGDP Phase II Site Investigation

Well Group Number	Well Group Location	Well No.	Plant Grid Coordinates N	Plant Grid Coordinates E	Top of 2" casing Elevation (ft msl)	Hydrogeologic Unit	Screened Interval (ft bgs)	Reasons for Well Locations
8	WMU 2 and 3-Downgradient	MW-171	S0471	W5418	374.63	Shallow gs	18 - 23	Evaluate water quality downgradient from WMU 2 and3
9	WMU 2 and 3-Downgradient	MW-172	S0192	W5978	373.79	Shallow gs	22 - 27	Evaluate water quality downgradient from WMU 2 and3
10	WMU 17 and 18-Upgradient of Lagoons	MW-173 MW-174	N1020 N1021	W5290 W5307	373.30 373.29	Upper RGA Shallow gs	53 - 58 23 - 28	upgradient coverage for C-616 lagoons
11	WMU 47- Tc99 Tank	MW-175 MW-176	S1428 S1444	W4379 W4380	381.18 381.23	Upper RGA Shallow gs	75 - 80 32.5-37.5	Evaluate migration of contaminants from C-400
12	WMU 40-Neutralization Tank	MW-177 MW-178	S1228 S1216	W4074 W4073	379.74 378.80	Shallow gs Upper RGA	39.5-44.5 62.5-67.5	Evaluate migration of contaminants from C-400
13	WMU 10- Inert Landfill	MW-179 MW-180	N4639 N4627	W3266 W2494	358.60 358.11	Upper RGA Shallow gs	52 - 57 22 - 27	Evaluate migration of contaminants from landfill
14	WMU 9-Residential Landfill	MW-181 MW-182	N3107 N3107	W3043 W3027	370.84 371.15	Upper RGA Shallow gs	52 - 57 15 - 20	Evaluate migration of contaminants from landfill

Table 4-1
Stage A Monitoring Well Location Data
PGDP Phase II Site Investigation

Well Group Number	Well Group Location	Well No.	Plant Grid Coordinates		Top of 2" casing Elevation (ft msl)	Hydrogeologic Unit	Screened Interval (ft bgs)	Reasons for Well Locations
			N	E				
15	WMU 8- Sanitary Landfill	MW-183 MW-184	S3938 S3930	W7441 W7003	380[c]	Upper RGA Shallow gs	N/A 10.5 - 13	Evaluate migration of contaminants from landfill to Big Bayou Creek[e]
16	WMU 7- Burial Ground	MW-185 MW-186	N0953 N0953	W6602 W6581	373.64 373.62	Upper RGA Shallow gs	68 - 73 18 - 23	Provide water levels in area; evaluate releases from WMU 7
17	WMU 30- Burn Area	MW-187	N0964 S2057 S2075	W6854	373.24	Shallow gs	21.5-26.5	Evaluate downward migration of contaminants detected in MW-66
18	WMU 1- South of Oil Landfarm	MW-188 MW-189		W7001 W6998	374.24 375.50	Upper RGA Shallow gs	70 - 75 22.5-27.5	Provide water levels; evaluate releases from area
19	WMU 5- Classified Burial Yard	MW-190	N0238	W6952	373.20	Shallow gs	17.5-22.5	Evaluate migration of contaminants from WMU 5

[a]RGA = Regional Gravel Aquifer in Lower Continental Deposits.
[b]Shallow gs = Shallow groundwater system in Upper Continental Deposits.
[c]Is approximate elevation, survey data not currently available.
[d]MW-161 was abandoned and replaced with MW-161A.
[e]MW-183 was not installed; did not encounter the Regional Gravel Aquifer.

Wells were screened over a 2½- to 7-foot depth interval. Well screen lengths were kept discrete in order to screen only the permeable sands within the Upper Continental Deposits and to check water quality and water level variations in the upper and lower portions of the RGA.

METHODOLOGY

DRILLING

Drill rigs were mobilized to the PGDP site on November 26, 1990. From November 26 through 28, initial rig inspection (by Energy Systems) and decontamination of rigs, tools, and downhole equipment was performed. Decontamination procedures are discussed later in this memorandum. In addition to the initial drill rig decontamination, the rigs were decontaminated before moving to a new well group location (Table 4-1). Rigs were not decontaminated between wells in a single group location. Tools and downhole equipment were decontaminated between drilling each borehole and before continuing to drill below the isolation casing after the isolation casing was set.

Drill rigs were set up on staked locations approved by Energy Systems under an excavation permit. Some drilling locations also required a hazardous work permit or radiation work permit, as determined by Energy Systems and Eberline, respectively. Conditions of each of these permits were discussed with people working at the permitted location before work began.

A gravel working pad was installed before well construction at all but two drilling locations (MW-175/176 and MW-177/178). The gravel working pad, approximately 30 by 40 feet, was installed to facilitate access and to prevent the of contamination from spreading. Before drilling, an exclusion zone was established to control access into and out of the working area. An example of an exclusion zone set-up is shown on Figure 4-2. The exclusion zone was established using rebar stakes and flagging to create a boundary. After drilling began, all persons and equipment leaving the exclusion zone were monitored by the IH/HP for radioactive contamination before leaving the zone.

An outer construction zone was established outside of the exclusion zone (Figure 4-2). The outer zone was made large enough to contain the drill rig mast in case of a drill rig upset. It also served as a corridor for the driller's equipment trucks and trailers to drop off and remove supplies. Level D dress was required to enter the outer zone. No monitoring was required to leave this zone.

Drilling was conducted by two truck-mounted CME 75 rigs and one truck-mounted CME 55 rig. Seven and 3/4-inch OD hollow stem augers (HSA) (3-3/4-inch ID) were used to drill, and sample boreholes were to be installed with a 2-inch ID well string.

Twelve inch flight augers were used to ream the 7-3/4-inch boreholes to set the 8-inch OD isolation casing.

The drilling sequence proceeded in the following order at a well group with both a shallow aquifer system well and a RGA well. At the RGA well location, a 7-3/4-inch borehole was advanced and continuously sampled with a 5-foot by 3-inch ID, stainless steel, split barrel, CME continuous sampler to the depth of the isolation casing (typically 30 to 50 feet). The borehole was then reamed and cleaned out using the 12-inch flight augers. These augers were removed from the hole (the hole stayed open due to the high percentage of clay or stable formation in the upper 50 feet) and the 8-inch isolation casing was placed in the bottom of the reamed 12-inch borehole. The isolation casing was then grouted in place and allowed to set at least 12 hours before drilling continued. The next day 7-3/4-inch augers were advanced inside the 8-inch isolation casing to the total RGA well depth, while continuous samples were collected. All samples were collected in 5-foot runs using the 5-foot continuous sampler. After the RGA well was installed, the shallow borehole was drilled using the 7-3/4-inch HSA augers to the total well depth, as determined from the lithologic log of the RGA borehole. No sampling was typically performed in the more shallow borehole(s) in a well group.

BOREHOLE LOGGING

The Sample Team Leader (STL) logged the boreholes during drilling. In two borehole locations, MW-169 and MW-189, a sample technician (ST) assisted in logging part of the borehole. Descriptions of the soils collected during drilling and sampling were recorded on standard form D1586, in accordance with CH2M HILL's "Standard Procedures for Logging of Soil Borings," (January 26, 1990). The soil boring logs are included as Attachment 4-B. These logs correspond to the deepest borehole at each well group (Table 4-1). In the case of the Cylinder Drop Test location (WMU-91), MW-159 was logged for the upper 35 feet and MW-158 for the interval 35 feet to 110 feet. Recorded information, in addition to lithologic descriptions, include HNu and radiological field readings and pocket penetrometer values for recovered samples.

In addition to the borehole logs, the STL kept a field logbook that contains a chronologic diary of the work completed each day at a given well location. Logbook reference numbers are indicated on the well completion diagrams (Attachment 4-C). Field logbooks may be reviewed at the Paducah CH2M HILL field office. These books contain the names of onsite personnel, descriptions of the field methods, any unusual or notable occurrences during the work, diagrams of the installed wells, tables of materials installed and removed from the well borehole, and tables of waste drum numbers used to contain wastes from the well cluster.

SOIL SAMPLING

Continuous soil samples were collected in the deepest borehole at each well group location. Samples were obtained using a 5-foot-long, 3-inch ID split barrel, stainless steel, CME continuous sampler, that provided continuous soil sampling during hollow stem auger drilling. The sampling barrel fit within the lead auger, extending a short distance in front of the auger head, allowing sampling to occur in advance of the augers. The Task Instructions required continuous soil samples to the top of the RGA, and then at 5-foot intervals thereafter. Because a CME continuous sampler was used for sampling, samples were collected continuously to the total depth. All soil samples were screened with a P.I. 101 HNu for volatile compounds and with an AC-3 Alpha Probe and HP-210 or HP-260 Gamma Probe for radioactivity, then lithologically logged. Well screen locations were chosen based on soil sample lithology.

Several changes from the Well Installation Task in the Phase II Workplan were made to locations for collecting soil samples for laboratory analysis. Since wells were installed to determine extent and concentrations of contaminants in the groundwater, soil samples were likewise obtained to determine extent and concentrations of contaminants in the unsaturated zone(s). Therefore, analytical soil samples were generally restricted to the fine-grained soils in the Upper Continental Deposits.

Three well group locations (No. 11, 12, and 13; Figure 4-1) were placed close to locations of planned deep soil borings so that they were substituted for borings. In these locations, continuous soil samples for laboratory chemical analysis were collected to the total depth. Sample identification numbers are shown on borehole logs, under the "Sample Number/Type" heading (Attachment 4-B), at the intervals where samples were collected for laboratory analysis.

For the remainder of the well group locations, two to three soil samples from the deepest boring were collected in jars for laboratory analysis. The purpose of these samples was to determine whether or not contaminants occur in the unsaturated zone at the well location. Laboratory samples were generally collected from the 5- to 10-foot depth interval, the clayey interval in which the isolation casing was set (for RGA wells), and occasionally another clayey interval between these two intervals. If contamination was detected during field screening, a laboratory sample was generally collected from that interval.

These laboratory samples were composited over the 5-foot interval by collecting stainless steel spoonfuls of soil along the CME split spoon core, mixing the soil in a stainless steel bowl, and then transferring the composited soil sample to sample jars. For Wells MW-155 through WM-178 and Wells MW-185 through MW-190, volatile organic analysis (VOA) vials were filled after the soil was mixed in the bowl. This procedure was later changed for Wells MW-179 through MW-184 so that VOA vials were filled directly from the sample core barrel.

The following quantities were collected for each sample:

- One 60-ml glass jar for field screening laboratory

- Two 40-ml glass vials for target compound list (TCL) volatile organic contaminants
- One 250-ml glass jar for TCL semivolatiles and pesticides/PCBs
- One 250-ml glass jar for target analyte list (TAL) metals
- One 250-ml glass jar for cyanide
- One 250-ml glass jar for dioxins and furans
- One-gallon plastic jar with 600-ml in for radioisotopes
- One 500-ml plastic or glass jar for radiological archive

One waste sample was composited over the entire depth of the deepest well cluster borehole for laboratory analysis to determine if drummed soil cuttings should be handled as hazardous material. Several spoonfuls of soil along the length of each continuous sample were placed into a stainless steel bucket for this purpose. After the borehole reached total depth, the soil in the bucket was mixed and transferred to sample jars in the following quantities:

- One 60-ml glass jar for radioactivity
- Six 32-ounce glass jars for VOAs, TCLP, TCLP metals, PCBs/pentachlorophenol, radioisotopes, and general waste characteristics

Containers for soil samples were assembled and assigned sample identification numbers by the Sample Manager. The Sample Manager tracked QC samples and assigned one laboratory QC sample for every 20 samples per matrix. QC samples included a second sample for a depth interval to be used for a matrix spike or for a duplicate. A duplicate sample is collected to determine analytical precision for the samples. Matrix spike samples help determine accuracy. A method blank sample was collected one every 20 samples per matrix by rinsing the 5-foot continuous sampler with organic-free water. Method blank samples are indicative of potential contamination introduced as a result of the sampling method.

Sample jars were labeled with the client name (PGDP), sample identification number, date and time of sample collection, type of analysis, preservative, and the initials of the sampler. Samples were kept in custody of the STL or the ST until relinquished to the sample manager in Building 730. Chain of custody forms were completed in the field or in the 730 Building by the STL or ST.

Before shipment to an offsite laboratory, all samples were screened for gross alpha and gross beta counts in the Field Screening Laboratory (FSL). The purpose of this screening was to meet the shipping requirements of the U.S. Department of Transportation (DOT) for sample packaging and labeling, to determine whether to analyze for radionuclides, and to determine which of two organic analytical laboratories to send the sample. DOT requires that samples meet the FSL criteria of less than 2,000 pCi/g for shipping samples as nonradioactive material. CH2M HILL laboratories required that FSL results were less than 15 pCi/g for gross alpha and 50 pCi/g for gross beta in order to accept samples. If FSL sample results were greater than 15 pCi/g for gross alpha or 50 pCi/g for gross beta, then a full radionuclide analysis was conducted for the sample.

Samples were refrigerated until the arrival of the overnight carrier. Samples were packed in coolers with ice and shipped to appropriate laboratories for analysis.

Soil samples, designated as "geotechnical" samples, were also collected from deep boreholes for the purpose of grain size analysis. These samples were collected from the depth of the planned well screen interval. Geotechnical samples were placed in plastic bags labeled with the well number, depth interval, and sampler's initials. Plastic bags were then placed in 1-gallon plastic jars, sealed with tape, and stored in the FSL until shipment to the geotechnical laboratory. Nine samples (Table 4-2) were sent for grain size analyses.

WELL INSTALLATION

Lithologic logs (Attachment 4-B) from the deepest boring were used to select the screen interval, the isolation casing depth (if applicable), and the total well depth. STLs submitted copies of lithologic logs and the field logbook to the Task Manager, daily. Based on daily submittals of lithologic logs and information relayed from the field by the STL, the Task Manager specified the screen interval for each Stage A monitoring well.

Wells were installed by three separate field crews under the field direction of a CH2M HILL STL (geotechnical engineer or hydrogeologist). Approved well construction materials were supplied by Brotcke Engineering and checked and noted in the field by the STL for conformance with specifications. Well construction diagrams are included in Attachment 4-C.

The RGA wells have an 8-inch OD, steel, isolation casing installed to the depth of a fine-grained soil interval, located between possible saturated zones in the shallow aquifer system and the RGA. The casing was installed inside a 12-inch ID borehole and the 4-inch annular space was grouted, using a tremie pipe. No further drilling was conducted until the grout set at least 12 hours.

Starting no sooner than the next day, the RGA borehole was advanced to total depth (inside the isolation casing), either to the top or bottom of the RGA. The RGA was easily identified during drilling by a "chattering" of the drill rig and/or by a significant decrease in sample recovery from the continuous sampler. The well boreholes were drilled a few feet below the depth at which the well screen was to be placed. This allowed for caving of the formation before the well string was installed and for

Table 4-2
List of Samples Submitted for Grain Size Analysis
PGDP Phase II Site Investigation

Well Number	Sample Interval (ft.bgs)	Strati-Graphic Zone	Logged Soil Description
MW-187	20 - 25	UCD[1]	Lean Clay/Well Graded Sand with gravel
MW-190	18 - 23	UCD	Poorly Graded Sand with gravel
MW-163	95 - 100	LCD[2]	Poorly Graded Sand/Well Graded gravel
MW-172	20 - 25	UCD	Well Graded Gravel with sand
MW-171	20 - 25	UCD	Well Graded Gravel with sand
MW-175	75 - 80	LCD	Well Graded Gravel with sand
MW-161A	80 - 85	LCD	Well Graded Gravel with sand
MW-188	70 - 75	LCD	Silty Gravel
MW-185	70 - 75	LCD	Well Graded Gravel with sand

[1]UCD = Upper Continental Deposits.
[2]LCD = Lower Continental Deposits (Regional Gravel Aquifer).

placement of some gravel filter pack below the well screen.

The 2-inch ID well string was installed inside the 7-3/4-inch hollow stem augers to the depth interval specified by the Task Manager. The well string consisted of, from bottom to top, a 2-inch end cap, a 2½-foot to 7-foot length of 0.01-inch Johnson continuous slot constructed screen, and the appropriate length of blank casing (riser) to allow a 2- to 3.5-foot extension above ground. The well string material is Johnson type 304 stainless steel and is joined by factory threaded ends with chemically inert O-rings.

When the well string was in place, a gravel filter pack was installed from the bottom of the borehole to a depth 5 feet above the well screen. The gravel filter pack consisted of 16-30 mesh Colorado Silica sand. In one well, MW-180 (Figure 4-1), only 1 foot of gravel filter pack was mistakenly installed above the well screen. Because this installed shallow well had little water in it, another shallow borehole (MW-180A) was drilled adjacent to MW-180 to see whether this was due to low permeability deposits or to possible bentonite in the well screen. The borehole log, along with the log for the adjacent borehole, H-219 (Attachment 4-B), indicates relatively few permeable zones in the upper 30 feet at Well Group No. 13. After development, the well produced water of a pH of 7.0 and no grout/bentonite was detected in the bailed water; therefore, MW-180 was considered an acceptable well.

For wells screened within the RGA, the most difficult part of well installation was to install a complete gravel filter envelope around the well string. In most cases, the loose, saturated sands and gravels of the RGA caved and formed a natural filter envelope before a complete gravel filter envelope could be installed. On an average, 55 percent of estimated total gravel filter volume was installed around well screens within the RGA. The amount of gravel filter installed ranged from none in MW-175 to 3-1/2 bags in MW-178. In cases where little gravel filter pack was placed, the natural formation served as the gravel filter pack. The amount of fine-grained sand, silt, and clay particles in the formation interval around the screen usually determined how quickly (or if) these wells cleared during development.

For shallow wells, an average of 75 percent of the estimated total gravel filter volume was installed around well screens in deposits above the RGA. The amount of gravel filter installed ranged from approximately 57 percent in MW-174 to 100 percent in MW-184. The amount of gravel filter pack placement, however, did not appear to be an important factor in determining how quickly shallow wells cleared during development. The permeability and thickness of deposits in hydraulic connection with the screen usually determined how quickly (or if) these wells cleared during development.

Above the gravel pack, specifications required a minimum 4-foot bentonite seal. The seal was placed with a tremie pipe using a 1:1 mixture of Naturalgel® powdered Wyoming bentonite and potable water. The thickness of this seal ranged from 4 feet to 10 feet in wells. The bentonite seal was placed as a hydrated slurry; therefore, no setting time was necessary before placing the grout above the bentonite seal. Where it was difficult to measure the depth of the hydrated bentonite seal with a weighted tape, an approximate volume of 1½ bags of bentonite and 8 gallons of water was mixed in the grout plant and pumped via ¼-inch tremie pipe into the annular space. This produced at least a 5-foot seal in the 3-inch annular space.

The annular space from above the bentonite seal to the ground surface was grouted. Lonestar Type I, portland cement was mixed in batches consisting of approximately two bags of cement, 15 gallons of potable water, and one-quarter bag of bentonite. The grout was mixed in a grout plant and pumped into the annular space using a 1-inch-diameter PVC tremie pipe or 1-inch flexible plastic tubing.

All monitoring wells were installed as described above and developed before pads, posts, and protective casings were installed. Protective casings were constructed of 6.625-inch OD, ASTM A53, Grade B steel with hinged locking caps. The protective casings were approximately 6-feet long with approximately 3 feet installed and grouted below ground surface, and the top of the protective casing was 4 inches higher than the top of the well riser. The protective casings were set into 4-foot square reinforced concrete pads approximately 3/4-foot thick. The wells were further protected by installing four 3-foot-high guard posts at corners 5 feet away from the well. Guard posts consisted of the same steel pipe as the protective casing, installed approximately 3 feet below ground surface and filled with cement. Protective casings and posts were painted a bright yellow color, similar to the color of the wells installed during Phase I of the PGDP Site Investigation.

On the north side of the concrete pad, two circular brass plates were installed in the concrete at the base of the protective casing. Inscribed on the plates are the well identification number, the surveyed well coordinates, and the ground surface elevation of the brass plates. Gravel working pads were removed at approximately half of the well group locations after the concrete pads were installed.

WELL DEVELOPMENT

Stage A wells were developed from January 3 through March 8, 1991. The development procedure involved surging, bailing, and airlift pumping so that representative formation water may be subsequently sampled from the wells. Wells screened within the shallow aquifer were surged and bailed for development. Air lift methods could not be employed in shallow wells because of slow water recovery and/or inadequate submergence for the airline.

The sequential well development procedure proceeded as follows. Each well was sounded for total depth and water level then surged with a stainless steel surge block throughout the screen interval. Each 1-foot increment of well screen was surged for approximately 15 to 20 minutes using a consistent up and down motion of the surge block, thereby drawing fine sediments into the well screen.

After surging, the well was bailed using a stainless steel bailer to remove accumulated sediments. If more than 1-foot of sediment was measured within the well, bailing was continued until the water removed contained approximately less than 10 percent sediments, as visually determined using a 5-gallon bucket of bailed water that was allowed to settle. If less than 1 foot of sediment was measured in the well, then air lift pumping was initiated on the RGA wells to complete the well development. For shallow wells, bailing was continued until criteria for well development were met and the Task Manager approved the completion of development for that well.

Well development was complete after removal of a minimum of five times (casing volume + water added to the well), field parameters of conductivity and pH were stable, and the water had cleared sufficiently or, if water was still turbid, the Task Manager approved the completion of development. Field parameters were considered stable when pH varied by less than 0.5 units, and specific conductance varied by less than 10 percent over three sequential water samples. These data were recorded in field logbooks.

The total volume of water removed from each well and the values of stabilized field parameters are shown in Table 4-3. The total volume of water removed from each well was greater than the criteria specified above because five volumes were not sufficient to result in clear well water. Clear water was defined as water that appears to be a light pinkish-brown or clearer when observed in a white, 5-gallon bucket. Generally, the water pumped from the RGA wells became clear. However, shallow wells often did not produce enough water to achieve clarity by bailing. Shallow wells were bailed at intervals of time until the necessary volume was removed, the parameters stabilized, and the Task Manager approved the completion of development based on the hours spent, volume removed, rate of well recovery, and water color descriptions.

Monitoring Well-161 (a RGA well) did not clear after 24 hours of development. During well development sand was sounded inside of the well screen. Because the measured sand level did not decrease with continued pumping, this well was not considered acceptable. MW-161 was abandoned by pressure grouting inside the well casing to the ground surface. MW-161 was replaced with MW-161A.

DECONTAMINATION OF EQUIPMENT

The purpose of consistent decontamination procedures is to prevent the spread of possibly contaminated material between boreholes and samples and from the immediate work area around the well borehole. Drilling and sampling equipment were decontaminated according to Energy Systems methods ESP-900 and ESP-901. Before setting up at a drilling location, a drill rig was decontaminated by steam cleaning, according to ESP-901. The drill rig was steam cleaned between well group locations, but not between wells within a group. Steam cleaning took place at the offsite decontamination pad.

Downhole equipment (drill rods, bits, augers, samplers, etc.) was decontaminated, according to ESP-900 as follows: (1) detergent/potable water wash, (2) potable tap water rinse, (3) organic-free water rinse, (4) isopropanol rinse, (5) organic-free water

Table 4-3
Stage A Monitoring Well Development Data
PGDP Phase II Site Investigation

Well No.	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	Parameters pH (SU)	Cond. (Umho)	Temp. (°C)	Color	Comments
MW-155	RGA[1]	45	5.5	2	6.3 6.1 6.2	180 180 180	10 9 10	Light pink-brown	Well developed 01-08-91 HNu up to 15 ppm in casing 0 ppm in breathing zone
MW-156	RGA	195	9.5	7	7.8 7.9 7.2	280 280 280	13 12 12	Light pink-brown	Well developed 01-14-91. HNu up to 150ppm in casing 0 ppm in breathing zone
MW-157	Shallow gs[2]	24	3	0	6.7 6.7 LO BAT	190 200 200	10 11 10	No record	HNu=20 ppm in casing to 100ppm in bucket. Well developed on 01-15-91.
MW-158	RGA	1353	12	27	7.1 7.1 7.1	180 180 180	14 13 13	Very clear	Well developed on 02-26-91
MW-159	RGA	415	13.25	9.5	6.1 6.2 6.1	90 89 90	12 13 13	Cloudy	Well developed on 01-06-91 Grout flakes found in the well
MW-160	Shallow gs	23	2	0	6.7 6.7 6.6	360 365 370	14 14 14	Murky	Well developed on 02-26-91
MW-161 MW-161A	RGA RGA	22.5 677	2.25 7	0 9.5	 7.5 7.5 7.5	 192 192 190	 16 16 16	Clear	Well was replaced with 161A Well developed on 2-18-91.
MW-162	Shallow gs	175	17	0	7.1 7.7 7.6	413 400 383	12 13 11	Moderate brown cloudy	Well developed on 02-18-91

Table 4-3
Stage A Monitoring Well Development Data
PGDP Phase II Site Investigation

Well No.	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	Parameters			Color	Comments
					pH (SU)	Cond. (Umho)	Temp. (°C)		
MW-163	RGA	1065	7.5	7	7.6 7.7 7.5	355 360 360	16 16 17	Moderate yellow brown	Well developed on 02-08-91
MW-164	Shallow gs	32	8	0	7.0 7.0 7.0	339 336 323	15 15 15	Cloudy	Well developed on 02-22-91
MW-165	RGA	250	5.75	2.8	6.7 6.6 6.9	315 255 335	14 15 15	Clear	Well developed on 02-07-91
MW-166	Shallow gs	16.5	3.5	0	7.1 7.0 7.1	240 245 245	16 17 18	Low turbidity	Well developed on 02-28-91 Bails dry. 3 to 4' of water in well
MW-167	Shallow gs	37	3.75	0	7.2 7.2 7.2	422 427 424	13 14 14	Light brown cloudy	Well developed on 02-22-91 Slow water recovery
MW-168	RGA	292	3.75	4.5	7.2 7.4 7.4	120 119 119	15 15 15	Clear	Well developed on 02-01-91
MW-169	RGA	190	5	6	7.0 6.9 7.2	75 70 70	11 11 11	Clear	Well developed on 02-06-91
MW-170	Shallow gs	79	9.75	0	6.7 6.7	368 363	11 11	Cloudy	Well developed on 02-25-91
MW-171	Shallow gs	54	5	0	5.8 5.7 5.8	195 190 190	15 15 15	Clear	Well developed on 02-28-91

Table 4-3 Stage A Monitoring Well Development Data PGDP Phase II Site Investigation										Page 3 of 5
					Parameters					
Well No.	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	pH (SU)	Cond. (Umho)	Temp. (°C)	Color	Comments	
MW-172	Shallow gs	73	6	0	6.9 6.4 7.4	250 245 250	15 15 10	Fairly clear	Well developed on 02-14-91. Bails dry.	
MW-173	RGA	560	3.5	15	7.1 7.3 7.4	220 220 225	10 10 10	Light brown	Well developed on 02-14-91	
MW-174	Shallow gs	29.5	5.5	0	6.9 6.8 6.8	445 450 470	13 14 14	murky	Well developed on 02-14-91 Bails dry.	
MW-175	RGA	830	3	19	7.6 7.6 7.6	500 490 480	17 17 17	Light brown alternates with clear	Well developed on 02-25-91 No gravel pack in well; formation caved around	
MW-176	Shallow	0	3	0					Well is dry	
MW-177	Shallow gs	14.75	6.25	0	6.6 6.6 6.7	350 355 355	18 18 18	Murky brown	Only 4' water in well. Well developed on 03-05-91	
MW-178	RGA	410	2	11	7.7 6.9 7.0	432 430 420	20 20 19	Clear	Well developed 02-20-91 Problems with pH meter so brought new pH meter	
MW-179	RGA	276	2.5	5.5	7.5 6.9 6.7	600 650 650	12 14 14	Light orange	Well developed on 02-28-91	
MW-180	Shallow gs	22.5	6	0	6.9 6.9 7.0	580 585 590	15 15 15	Murky light brown	Only recovers partially in 24 hours.	

Table 4-3
Stage A Monitoring Well Development Data
PGDP Phase II Site Investigation

Well No.	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	Parameters			Color	Comments
					pH (SU)	Cond. (Umho)	Temp. (°C)		
MW-181	RGA	350	3	11	6.7 7.0 7.2	330 335 330	13 14 14	Clear	Well developed on 03-04-91
MW-182	Shallow gs	18.5	6.5	0	6.8 6.9 6.9	610 620 625	15 15 15	Dark brown	Well developed on 03-07-91
MW-184	Shallow on the terrace	27.5	6.25	0	6.6 6.7 6.9	610 610 615	13 13 14	Light brown muddy	Bails dry.
MW-185	RGA	290	2	4.5	7.0 6.8 6.9	300 300 298	14 14 14	Clear	Well developed on 02-22-91
MW-186	Shallow gs	39.5	4.5	0	6.1 6.1 6.1	2190 2290 2280	14 16 15	Cloudy	Bails dry. Well developed on 02-28-91
MW-187	Shallow gs	63.5	4.25	0	6.4 6.5 6.5	720 700 740	14 14 15	Low turbidity	Well developed on 03-01-91
MW-188	RGA	900	2	9.3	7.0 7.1 7.1	190 187 185	15 15 15	Clear	Well developed 2-14-91.
MW-189	Shallow gs	78	7.75	0	6.6 6.7 7.0	165 165 170	15 15 16	Cloudy brown	vinyl chloride draeger tube dropped in well. Well developed on 03-05-91

Table 4-3
Stage A Monitoring Well Development Data
PGDP Phase II Site Investigation

Well No.	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	Parameters pH (SU)	Cond. (Umho)	Temp. (°C)	Color	Comments
MW-190	Shallow gs	69	5.25	0	6.8 6.3 6.9	950 920 880	15 15 13	Cloudy	Well developed 2-14-91

[1]RGA is the Regional Gravel Aquifer in Lower Continental Deposits
[2]Shallow gs is the shallow groundwater system in Upper Continental Deposits
LO B is low battery readout on field pH meter

rinse, and (6) air drying. Downhole and soiled equipment (i.e., horses, pipe wrenches, tools) was decontaminated between each well location and before drilling below the isolation casing in the RGA wells. Decontamination occurred at the offsite decontamination pad.

Downhole equipment such as soil samplers were decontaminated between each use in the field at the drill site using a metal trough to collect the decontaminated water. Samplers were laid on a screen over the trough, and stainless steel, pressurized sprayers, containing detergent, potable water, organic-free water, and isopropanol were used with brushes to clean the samplers at the site. After cleaning and air-drying, the samplers were scanned by the IH/HP with an HNu for a final check before reentering them in the borehole.

The remainder of the downhole equipment was wrapped in plastic, loaded on a trailer, and carried to the decon pad for decontamination, using the same procedure, but with hot water from the steam cleaner. Decontaminated equipment was then wrapped in plastic and transported to the drill site. There was no IH/HP coverage at the offsite decontamination pad to scan decontaminated equipment. However, team members visually inspected equipment as it was used at a new borehole or below the isolation casing.

STLs were responsible for preventing cross-contamination between soil samples collected for laboratory analysis. Sample preparation tables were wrapped with clean, disposable, plastic between analytical samples. Disposable plastic was laid beneath tables and around the borehole to catch soils dropped on the ground. Stainless steel bowls and implements were decontaminated either at the decontamination pad or drill site between samples.

Personal protective equipment and disposable items were disposed of into labeled PPE drums before leaving the exclusion zone at a drill site.

There was one well group location, MW-177/-178 (Figure 4-1), where development equipment (a crane) was moved out of the exclusion zone and decontaminated before being moved out of the plant. Wet soil conditions, no drill pad, and variously elevated radioactivity readings in the area created conditions for the possibility of spreading contaminants. The crane was driven up a ramp onto a plastic covered flatbed trailer where it was taken to the onsite decontamination pad for cleaning.

WASTE MANAGEMENT

Potentially hazardous wastes generated during the Stage A well installation task include borehole soils (drill cuttings), disposable personal protective equipment (PPE), and fluids removed from the borehole, the well, or generated by decontaminating equipment. These wastes were segregated by type (soils, PPE, and waste water) and by location.

Soils, or drill cuttings, were contained and segregated by well or borehole number, well development water was contained and segregated by well cluster and composited into 1,200-gallon storage tanks at the PGDP Secured Storage Area (SSA), and field decontamination waste water was pumped into drums at the well site or transported to the offsite decon pad and pumped into decontamination water tanks. Ultimately, wastes were transported and stored in the SSA until chemical classification to determine their release.

Brotcke Engineering was responsible for drumming wastes in 55-gallon drums at a drill site and transporting drummed wastes from each well cluster location to the SSA. The Waste Manager assigned drum numbers to the STL, who labeled drums. Soils were shoveled from the metal plate around the borehole directly into lined, 55-gallon drums. Well development water was either bailed into 55-gallon drums or pumped into a 600-gallon mobile tank at the well group. Mobile tanks were transported to SSA and pumped, under the direction of the Waste Manager, into 1,200-gallon storage tanks.

A waste composite sample, as described under the Soil Sampling section, was collected by the STL at each cluster location.

INTERPRETATION

Data collected during Stage A well installation include lithologic logs and HNu and radiological screening data. Figure 4-3 shows Stage A locations where there were no appreciable deposits logged as lean clays (aquitards) encountered between the permeable zones in the shallow aquifer system and the RGA. Also shown are locations where no shallow saturated sand or sand and gravel zones were recorded in the Upper Continental Deposits. These locations theoretically represent opportune and inopportune conditions for contaminants to migrate downward to the RGA.

Also indicated on Figure 4-3 are locations where soil sample(s) had HNu or radiological screening data values greater than background. These data will be checked against laboratory soil and groundwater data when they are available.

REFERENCES

CH2M HILL. "Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant." December 21, 1990.

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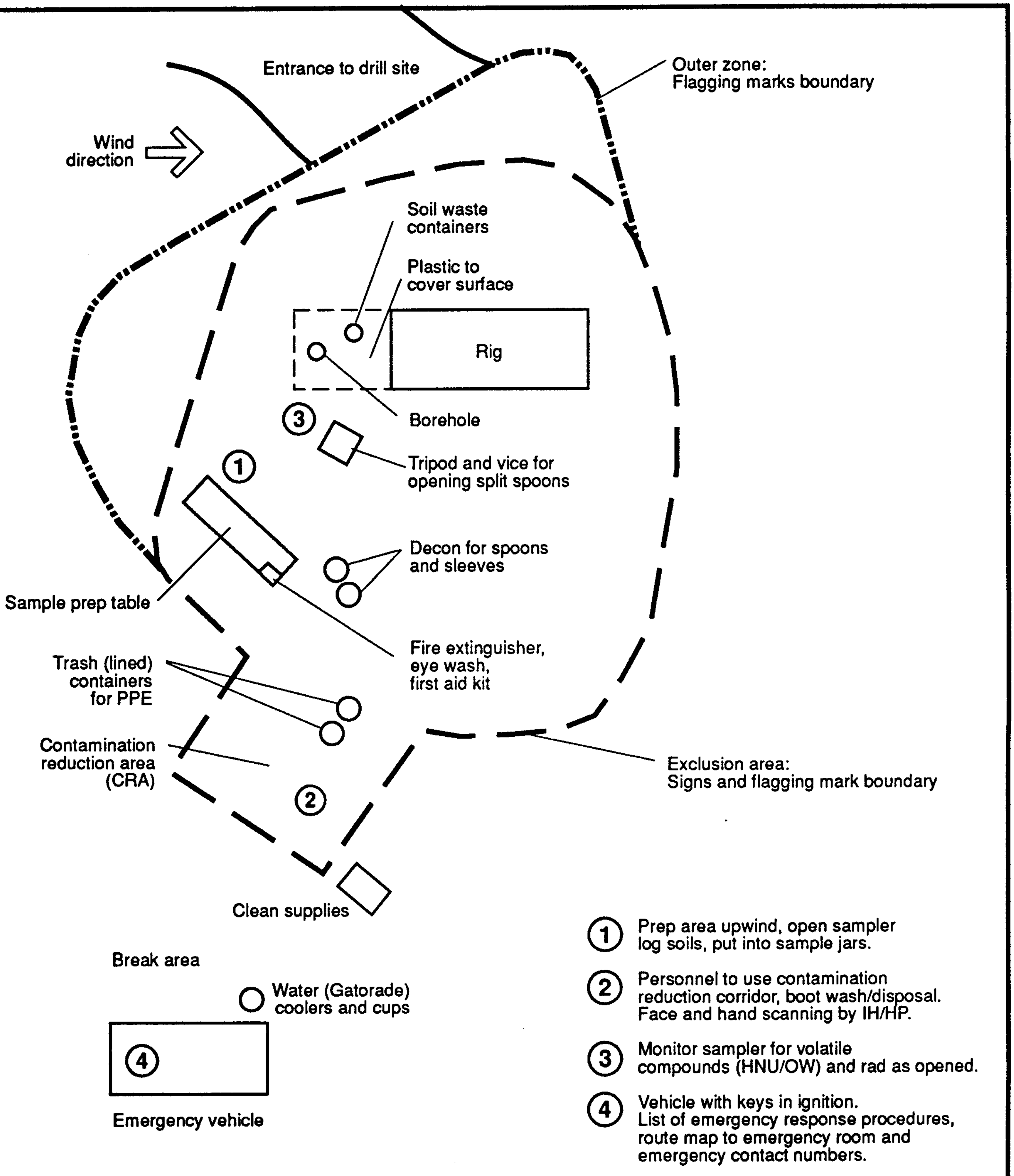


Figure 4-2

DIAGRAM OF A TYPICAL WORKING ZONE

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

Attachment 4–A

Field Exploration Data

Attachment 4-A
Field Exploration Information

WELL GROUP NO. 1: WMU 11 - TCE Leak Site

MW-155	Equipment	Onsite Personnel
installation: 12-05-90/12-12-90 development: 01-03-91/01-08-91 Well TD = 92 ' below pad surface	CME 75 rig 12 " continuous flight augers to 46' 7 3/4" O.D. CME augers to 95' 5' x 3" ID CME sampler	J. Anderson (STL-CH) B. Souza (ST-CH) A. Grigsby (IH/HP-EB) D. Spencer (escort-CH) C. Faus (BR) R. Holder (BR) R. Dependahl (BR) H. Fowler (escort-CH) E. Pomar (CH) D. Frain (IH/HP-EB) J. Houston (escort-CH) T. Boone (BR) M. Umfleet (BR)

MW-156	Equipment	Onsite Personnel
installation: 12-13-90/12-19-90 development: 01-07-91/01-14-91 Well TD = 70' below pad surface	see MW-155, except 7 3/4" augers to 75'	(see MW-155) plus M. Kizilbash (BR) M. Jackson (escort-CH) C. Thompson (BR) B. Moya (IH/HP-EB) P. Eggering (BR)

MW-157	Equipment	Onsite Personnel
installation: 12-19-90/12-19-90 development: 01-07-91/01-15-91 Well TD = 35' below pad surface	CME 75 rig 7 3/4" O.D. CME augers to 37' 5' x 3" ID CME sampler	(see MW-155) plus C. Thompson (BR)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 2: WMU 91 - Cylinder Drop Test Area

MW-159	Equipment	Onsite Personnel
installation: 11-28-90/12-14-90 development: 01-17-91/ Well TD = 68' below pad surface	CME 55 rig 12 " continuous flight augers to 35' 7 3/4" O.D. hollow stem augers to 70' 5' x 3" ID CME continuous sampler	G. Schaefer (STL-CH) B. Souza (ST-CH) D. Beard (IH/HP-EB) C. Leneave (escort-CH) G. Autry (BR) S. Umfleet (BR) N. Risner (BR) B. Nash (IH-CH) E. Pomar (CH) D. Frain (IH/HP-EB) J. Houston (escort-CH) T. Boone (BR) C. Thompson (BR)

MW-158	Equipment	Onsite Personnel
installation: 11-30-90/12-14-90 development: 01-15-91/01-18-91 Well TD = 108' below pad surface	CME 55 rig 12" continuous flight auges to 35' 7-3/4" hollow stem augers to 110' 5' x 3"ID sampler	(see MW-159)

MW-160	Equipment	Onsite Personnel
installation: 12-05-90/12-05-90 development: 01-18-91/01-18-91 Well TD = 25' below pad surface	CME 55 rig 7-3/4" hollow stem augers to 28'	(see MW-159)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 3: WMU 1 - North of Oil Landfarm

MW-161A	Equipment	Onsite Personnel
installation:	CME 55 rig	
01-30-91/02-01-91		G. Schaefer (STL-CH)
	12 " continuous	S. Wade (IH/HP-EB)
development:	flight augers to	J. Hayden (escort-CH)
02-11-91/02-18-91	40'	G. Autry (BR)
		S. Umfleet (BR)
Well TD = 83'	7 3/4" O.D. hollow	N. Risner (BR)
below pad surface	stem augers to 85'	
	5' x 3" ID CME	
	continuous sampler	

MW-162	Equipment	Onsite Personnel
installation:		
11-30-90/11-30-90	CME 75 rig	D. Geswender (STL-CH)
		J. Anderson (ST-CH)
development:	7-3/4" hollow	D. Morrison (IH/HP-EB)
01-28-91/02-18-92	stem augers to 25'	W. Cunningham (escort-CH
		J. Lutman (BR)
Well TD = 24'	5' x 3" ID CME	G. Shetley (BR)
below pad surface	continuous sampler	T. Childress (BR)
		B. York (ST-CH)
		S. McCarthy (BR)
		R. Hanger (BR)
		B. Moya (IH/HP-EB)
		M. Jackson (escort-CH)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 4: Eastern Part of Plant

MW-163	Equipment	Onsite Personnel
installation: 12-10-90/12-17-90 development: 01-25-91/02-08-91 Well TD = 99' below pad surface	CME 75 rig 12 " continuous flight augers to 55' 7 3/4" O.D. hollow stem augers to 100' 5' x 3" ID CME continuous sampler	D. Geshwender (STL-CH) B. Souza (ST-CH) D. Morrison (IH/HP-EB) W. Cunningham (escort-CH J. Lutman (BR) T. Childress (BR) G. Shetley (BR) B. Nash (SSC-CH) E. Pomar (STL-CH) D. Frain (IH/HP-EB) J. Houston (escort-CH) T. Boone (BR) C. Thompson (BR)

MW-164	Equipment	Onsite Personnel
installation: 12-18-90/12-19-90 development: 01-25-91/02-22-91 Well TD = 47' below pad surface	CME 75 rig 7-3/4" hollow stem augers to 48' 5' x 3" ID CME continuous sampler	(see MW-163) except B. Souza (ST-CH)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 5: Northern Part of Plant

MW-165	Equipment	Onsite Personnel
installation: 12-14-90/01-03-91 development: 01-29-91/02-08-91 Well TD = 68' below pad surface	CME 55 rig 12 " continuous flight augers to 60' 7-3/4" O.D. hollow stem augers to 70' 5' x 3" ID CME continuous sampler	G. Schaefer (STL-CH) B. Souza (ST-CH) D. Beard (IH/HP-EB) C. Leneave (escort-CH) G. Autry (BR) S. Umfleet (BR) N. Risner (BR) B. Nash (IH-CH) C. Leneave (escort-CH) E. Pomar (CH) D. Frain (IH/HP-EB) J. Houston (escort-CH) T. Boone (BR) C. Thompson (BR)

MW-166	Equipment	Onsite Personnel
installation: 12-20-90/12-20-90 development: 01-29-91/02-28-91 Well TD = 38' below pad surface	CME 55 rig 7-3/4" hollow stem augers to 40' 5' x 3" ID CME continuous sampler	(see MW-165) except B. Souza (ST-CH) B. Nash (SSC-CH)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 6: AREA A - Diesel Spill

MW-167	Equipment	Onsite Personnel
installation: 01-15-91/01-15-91 development: 01-31-91/02-01-91 Well TD = 26' below pad surface	CME 75 rig 7-3/4" O.D. hollow stem augers to 28' 5' x 3" ID CME continuous sampler	D. Geswender (STL-CH) D. Morrison (IH/HP-EB) W. Cunningham (escort-CH J. Lutman (BR) G. Shetley (BR) T. Childress (BR) E. Pomar (STL-CH) J. Houston (escort-CH) D. Frain (IH/HP-EB) T. Boone (BR) C. Thompson (BR)

MW-168	Equipment	Onsite Personnel
installation: 12-20-90/01-15-91 development: 01-30-91/02-01-91 Well TD = 68' below pad surface	CME 75 rig 12 " continuous flight augers to 35' 7-3/4" O.D. hollow stem augers to 70' 5' x 3" ID CME continuous sampler	(see MW-167) plus R. Dependahl (BR)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 7: WMU 2 & 3 - Downgradient (001-Ditch)

MW-169	Equipment	Onsite Personnel
installation: 12-20-90/01-08-91 development: 01-30-91/02-06-91 Well TD = 70' below pad surface	CME 75 rig 12 " continuous flight augers to 35' 7-3/4" O.D. hollow stem augers to 70' 5' x 3" ID CME continuous sampler	J. Anderson (STL-CH) B. Souza (ST-CH) D. Geshwender (ST-CH) D. Spencer (escort-CH) A. Grigsby (IH/HP-EB) C. Faus (BR) R. Dependahl (BR) R. Holder (BR) J. Lutman (BR) G. Shetley (BR) T. Childress (BR) H. Fowler (escort-CH) M. Jackson (escort-CH) B. York (ST-CH) Scott McCarthy (BR) R. Hanger (BR) B. Moya (IH/HP-EB)

MW-170	Equipment	Onsite Personnel
installation: 01-04-91/01-04-91 development: 01-31-91/02-25-91 Well TD = 30' below pad surface	CME 75 rig 7-3/4" O.D. hollow stem augers to 30' 5' x 3" ID CME continuous sampler	(see MW-169 except delete A. Grigsby and add D. Morrison)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 8: WMU 2 & 3 - Downgradient (001-Ditch)

MW-171	Equipment	Onsite Personnel
installation:		
01-04-91/01-07-91	CME 55 rig	G. Schaefer (STL-CH)
		B. Souza (ST-CH)
development:	7-3/4" O.D. hollow	D. Beard (IH/HP-EB)
02-05-91/02-05-91	stem augers to 25'	C. Leneave (escort-CH)
		G. Autry (BR)
Well TD = 23'	5' x 3" ID CME	S. Umfleet (BR)
below pad surface	continuous sampler	N. Risner (BR)
		G. Shetley (BR)
		G. Shaefer (CH)

WELL GROUP NO. 9: WMU 2 & 3 - Downgradient (001-Ditch)

MW-172	Equipment	Onsite Personnel
installation:		
01-07-91/01-08-91	CME 55 rig	(see MW-171) except
		G. Shetley (BR)
development:	7-3/4" hollow	
02-06-91/02-14-91	stem augers to 30'	
Well TD = 27'	5' x 3" ID CME	
below pad surface	continuous sampler	

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 10: WMU 17 & 18 - Upgradient of Lagoons

MW-173	Equipment	Onsite Personnel
installation: 01-09-91/01-15-91	CME 55 rig	G. Schaefer (STL-CH) B. Souza (ST-CH)
development: 02-08-91/02-18-91	12" continuous flight augers to 35'	D. Beard (IH/HP-EB) C. Leneave (escort-CH) G. Autry (BR)
Well TD = 58' below pad surface	7-3/4" O.D. hollow stem augers to 60'	S. Umfleet (BR) N. Risner (BR) C. Leneave (escort-CH)
	5' x 3" ID CME continuous sampler	

MW-174	Equipment	Onsite Personnel
installation: 01-16-91/01-16-91	CME 55 rig	G. Schaefer (STL-CH) C. Leneave (escort-CH)
development: 02-08-91/02-14-91	7-3/4" hollow stem augers to 30'	D. Beard (IH/HP-EB) S. Waide (IH/HP-EB) G. Autry (BR)
Well TD = 28' below pad surface	5' x 3" ID CME continuous sampler	S. Umfleet (BR) N. Risner (BR)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 11: WMU 47 - Tc-99 Tank; NW of C-400

MW-175	Equipment	Onsite Personnel
installation: 01-09-91/01-15-91	CME 75 rig	J. Anderson (STL-CH) B. Souza (ST-CH)
development: 02-20-91/02-26-91	12 " continuous flight augers to 40'	D. Spencer (escort-CH) A. Grigsby (IH/HP-EB) C. Faus (BR)
Well TD = 80' below pad surface	7-3/4" O.D. hollow stem augers to 80'	R. Dependahl (BR) R. Holder (BR) H. Fowler (escort-CH)
	5' x 3" ID CME continuous sampler	

MW-176	Equipment	Onsite Personnel
installation: 01-16-91/01-16-91	CME 75 rig	(see MW-175) except B. Souza (ST-CH)
development: 02-20-91	7-3/4" O.D. hollow stem augers to 37.5'	D. Spencer (escort-CH)
Well TD = 37.5' below pad surface	5' x 3" ID CME continuous sampler	

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 12: WMU 40 - Neutralization Tank; NE of C-400

MW-177	Equipment	Onsite Personnel
installation: 01-16-91/01-23-91	CME 75 rig	D. Geswender (STL-CH) D. Morrison (IH/HP-EB)
development: 02-14-91/03-05-91	7-3/4" O.D. hollow stem augers to 46.5'	W. Cunningham (escort-CH) J. Lutman (BR) G. Shetley (BR)
Well TD = 44.5' below pad surface		T. Childress (BR)

MW-178	Equipment	Onsite Personnel
installation: 01-16-91/01-22-91	CME 75 rig	(see MW-177) plus B. Souza (ST-CH)
development: 02-14-91/02-20-91	12 " continuous flight augers to 50'	B. Avolio (STL-CH) G. Stephens (IH/HP-CH) B. Nash (SSC-CH)
Well TD = 67.5' below pad surface	7-3/4" O.D. hollow stem augers to 69'	
	5' x 3" ID CME continuous sampler	

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 13: WMU 10 - Inert Landfill

MW-179	Equipment	Onsite Personnel
installation: 02-01-91/02-05-91	CME 75 rig	D. Geshwender (STL-CH) D. Morrison (IH/HP-EB)
development: 02-25-91/02-28-91	12" continuous flight augers to 39'	J. Lutman (BR) G. Shetley (BR) T. Childress (BR)
Well TD = 57' below pad surface	7-3/4" O.D. hollow stem augers to 59'	C. Kantowski (ST-CH) C. Thompson (BR) R. Scott (BR)

MW-180	Equipment	Onsite Personnel
installation: 01-30-91/01-30-91	CME 55 rig	(see MW-179) plus L. Kieffe (ST-CH)
development: 02-25-91/03-08-91	7-3/4" O.D. hollow stem augers to 30'	T. Boone (BR)
Well TD = 27' below pad surface		

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 14: WMU 9 - Residential Landfill

MW-181	Equipment	Onsite Personnel
installation: 02-06-91/02-12-91 development: 02-27-91/03-08-91 Well TD = 57' below pad surface	CME 75 rig 12 " continuous flight augers to 35.5' 7 3/4" O.D. CME augers to 60' 5' x 3" ID CME sampler	D. Geshwender (STL-CH) D. Morrison (IH/HP-EB) J. Lutman (BR) G. Shetley (BR) T. Childress (BR) L. Kieffe (ST-CH) B. York (ST-CH) T. Boone (BR) S. McCarthy (BR) C. Thompson (BR) W. Cunningham (escort-CH)

MW-182	Equipment	Onsite Personnel
installation: 02-08-91/02-08-91 development: 02-27-91/03-04-91 Well TD = 20' below pad surface	(see MW-181)	(see MW-181) plus C. Kantowski (ST-CH)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 15: **WMU 8 - Sanitary Landfill**

MW-183	Equipment	Onsite Personnel
installation: 01-24-91/01-29-91 development: not applicable Well TD = N/A	CME 55 rig 12" continuous flight augers to 25' 7-3/4" O.D. hollow stem augers to 70' 5' x 3" ID CME continuous sampler	G. Schaefer (STL-CH) S. Waide (IH/HP-EB) C. Leneave (escort-CH) G. Autry (BR) S. Umfleet (BR) N. Risner (BR) R. Hanger (BR)

MW-184	Equipment	Onsite Personnel
installation: 01-25-91/01-25-91 development: 02-27-91/03-08-91 Well TD = 13' below pad surface	CME 55 rig 7-3/4" hollow stem augers to 15'	G. Schaefer (STL-CH) S. Waide (IH/HP-EB) G. Autry (BR) S. Umfleet (BR) N. Risner (BR) C. Kantowski (ST-CH) L. Kieffe (ST-CH) C. Thompson (BR) T. Boone (BR)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 16: WMU 7 - Burial Ground

MW-185	Equipment	Onsite Personnel
installation: 01-16-91/01-23-91 development: 02-21-91/02-22-91 Well TD = 73' below pad surface	CME 55 rig 12" continuous flight augers to 40' 7-3/4" O.D. hollow stem augers to 75' 5' x 3" ID CME continuous sampler	G. Schaefer (STL-CH) S. Waide (IH/HP-EB) C. Leneave (escort-CH) G. Autry (BR) S. Umfleet (BR) N. Risner (BR) T. Boone (BR)

MW-186	Equipment	Onsite Personnel
installation: 01-21-91/01-22-91 development: 02-21-91/02-28-91 Well TD = 23' below pad surface	CME 55 rig 7-3/4" hollow stem augers to 25'	(see MW-185) plus L. Kieffe (ST-CH)

WELL GROUP NO. 17: WMU 30 - Burn Area

MW-187	Equipment	Onsite Personnel
installation: 01-16-91/01-17-91 development: 02-22-91/03-01-91 Well TD = 26.7' below pad surface	CME 75 rig 7-3/4" hollow stem augers to 40' 5' x 3" ID CME sampler	J. Anderson (STL-CH) H. Fowler (escort-CH) A. Grigsby (IH/HP-EB) C. Faus (BR) R. Holder (BR) R. Dependahl (BR) L. Kieffe (ST-CH) G. Schaefer (ST-CH) T. Boone (BR) C. Thompson (BR)

Attachment 4-A (Continued)
Field Exploration Information

WELL GROUP NO. 18: WMU 1 - South of Oil Landfarm

MW-188	Equipment	Onsite Personnel
installation: 01-21-91/01-23-91	CME 75 rig	J. Anderson (STL-CH) L. Darragh (STL-CH)
development: 02-11-91/02-14-91	12 " continuous flight augers to 40'	L. Kieffe (ST-CH) B. Souza (ST-CH) H. Fowler (escort-CH)
Well TD = 75' below pad surface	7-3/4" O.D. hollow stem augers to 75'	A. Grigsby (IH/HP-EB) C. Faus (BR) R. Dependahl (BR) R. Holder (BR)
	5' x 3" ID CME continuous sampler	P. Eggering (BR) G. Schaefer (STL-CH) C. Thompson (BR) R. Scott (BR) T. Boone (BR)

MW-189	Equipment	Onsite Personnel
installation: 01-24-91/01-24-91	CME 75 rig	(see MW-188) except B. Souza (ST-CH)
development: 02-12-91/03-05-91	7-3/4" O.D. hollow stem augers to 28.5'	L. Darragh (ST-CH)
Well TD = 27.5' below pad surface		

CLUSTER NO. 19: WMU 5 - Classified Burial Yard

MW-190	Equipment	Onsite Personnel
installation: 01-18-91/01-18-91	CME 75 rig	J. Anderson (STL-CH) A. Grigsby (IH/HP-EB) H. Fowler (escort-CH)
development: 02-08-91/02-14-91	7-3/4" O.D. hollow stem augers to 25'	C. Faus (BR) R. Dependahl (BR) R. Holder (BR)
Well TD = 22.5' below pad surface	5' x 3" ID CME sampler	B. York (ST-CH) S. McCarthy (BR) L. Kieffe (ST-CH) T. Boone (BR)

Attachment 4–B

Soil
Boring
Logs

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-155 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION S.E. Corner of C-400 Building

ELEVATION 2" TOC 381.25 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75 rig; 7-3/4" O.D. Auger & 12" CFA to 47'

WATER LEVELS START 12/05/90 FINISH 12/11/90 LOGGER Jim Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
					WELL GRADED GRAVEL [fill]		Background HNu: 0 ppm.
	1.0 to 5.0	5' Continuous	2.3		SANDY SILT WITH GRAVEL (ML) mod. yellow-brown (10 YR 5/4), trace clay, moist.		Background Rad: 40 cpm. HNu: 0 ppm.
					SILT (ML) medium gray (N5), moist.		
5	5.0 to 10.0	5' Continuous	5.0				Threads binding on sampler.
					LEAN CLAY (CL) mod. yellow-brown (10 YR 5/4) with occasional black (possibly organic) mottling; moist, low plasticity.		HNu: 0 ppm.
10	10.0 to 15.0	5' Continuous	5.0		LEAN CLAY (CL) as above; slightly more plastic, mottling pale yellow-brown (10 YR 6/2).		HNu: 4 ppm, quickly dissipated to 0. Rad: 70 cpm.
15	15.0 to 20.0	5' Continuous	5.0		LEAN CLAY (CL) as above.		HNu: 0 ppm. Rad: Background. Stopped for the day, 1600.
20	20.0 to 25.0	5' Continuous	5.0		SANDY LEAN CLAY (CL) pale yellow-brown (10 YR 6/2), moist; fine sand. Medium gravel from 21' to 22'.		Resumed drilling, 1005 12/06/90. Driller reports gravel from 21'-25'. HNu: 20 ppm (in bottom tip of sample). Rad: 80 cpm (in bottom).
25	25.0 to 30.0	5' Continuous	3.5		LEAN CLAY (CL) mod. brown (5 YR 4/4), moist; trace fine sand.		HNu: 4 ppm. Rad: 50 cpm
					WELL GRADED SAND WITH CLAY (SW-SC) light brown (5 YR 5/6), moist, fine sand.		

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-155	SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION S.E. Corner of C-400 Building

ELEVATION 2" TOC 381.25 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75 rig; 7-3/4" O.D. Auger & 12" CFA to 47'

WATER LEVELS START 12/05/90 FINISH 12/11/90 LOGGER Jim Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous	1.3		POORLY GRADED GRAVEL WITH SAND (GP) light brown (5 YR 5/6); medium gravel, fine sand; moist.		HNu: 4 ppm. Rad: 40 cpm.
35	35.0 to 40.0	5' Continuous	2.7		SANDY LEAN CLAY (CL) pale yellow-brown (10 YR 6/2), wet.		HNu: 4ppm. Rad: 40cpm.
40	40.0 to 45.0	5' Continuous 13011	5.0		SANDY LEAN CLAY WITH GRAVEL (CL) moderate yellow-brown (10 YR 5/4), mottled with light gray (N7); moist, medium gravel (poorly graded), fine sand. Gravel stops at 41'.		HNu: 2 ppm. Rad: 70 cpm.
45	45.0 to 50.0	5' Continuous	3.3				Stopped advancing for day: 12/6, 1100. Set 8" diam. I.D. Isolation Casing to 47'; 12/7. Begin advancing past isolation casing. HNu: 50 ppm.
50	50.0 to 55.0	5' Continuous	2.8		SANDY LEAN CLAY (CL) light gray (N7), moist, fine sand, trace silt.		Rad: 60 cpm. Rig chattering from 50'-51'. Driller reports gravel. HNu: 10 ppm. Rad: 65 cpm.
55	55.0 to 60.0	5' Continuous	1.1		POORLY GRADED SAND (SP) mottled light gray (N7) and light brown (5 YR 5/6), moist, fine to medium sand. Grades to grayish orange (10 YR 7/4), with medium gravel; gravel is subrounded.		HNu: 5 ppm. Rad: 35 cpm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-155 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION S.E. Corner of C-400 Building

ELEVATION 2" TOC 381.25 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75 rig; 7-3/4" O.D. Auger & 12" CFA to 47'

WATER LEVELS START 12/05/90 FINISH 12/11/90 LOGGER Jim Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	1.5		POORLY GRADED SAND (SP) as above, except gravel is subangular, and sample is wet.		Driller reports gravel at 60.5', along with 1' of heave in the bottom of the auger. HNu: 2 ppm. Rad: 60 cpm.
65	65.0 to 70.0	5' Continuous	1.6		POORLY GRADED SAND (SP) mod. yellow-brown (10 YR 5/4) and light gray (N7) grains; wet, medium sand.		HNu: 150 ppm Rad: 40 cpm.
70	70.0 to 75.0	5' Continuous	1.4		WELL GRADED GRAVEL WITH SAND (GW) mod. yellow-brown (10 YR 5/4); wet, subrounded gravel.		HNu: 2 ppm. Rad: 35 cpm. Draeger tubes (75') TCE: 17ppm VC: 6ppm.
75	75.0 to 80.0	5' Continuous	1.9		WELL GRADED GRAVEL WITH SAND (GW) as above.		1555 12/10 Stopped for day 0845 12/11 Restarted, driller reports 50' water level. HNu: 10 ppm. Rad:50 cpm.
80	80.0 to 85.0	5' Continuous	1.0		WELL GRADED GRAVEL WITH SAND (GW) as above, but little gravel recovery; most of the recovery is fine gravel and coarse sand.		HNu: 2 ppm. Rad: 50 cpm.
85	85.0 to 90.0	5' Continuous			WELL GRADED GRAVEL WITH SAND (GW) as above; again, little gravel recovery; some medium gravel in sampler shoe.		HNu: 17 ppm. Rad: 35 cpm.

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-155	SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION S.E. Corner of C-400 Building

ELEVATION 2" TOC 381.25 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75 rig; 7-3/4" O.D. Auger & 12" CFA to 47'

WATER LEVELS START 12/05/90 FINISH 12/11/90 LOGGER Jim Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90.0 to 95.0	5' Continuous	1.7		WELL GRADED GRAVEL WITH SAND (GW) as above.		Driller reports different feel in rig at 92.5'.
					SANDY LEAN CLAY (CL) dark yellow-orange (10 YR 6/6), wet, fine sand.		HNu: 2 ppm. Rad: 50 cpm.
95					Total Depth = 95.0 feet		
					Bottom of hole reached @1005 12/11/90.		
					Took sample 16001, a composite of the total depth of the hole for waste characterization.		
100							
105							
110							
115							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-158 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ____ **START** 11/30/90 **FINISH** 12/07/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0–20 (5, 10, 15)	0.0 to 20.0	5' Continuous			From 0 ft. to 20 ft., see boring log for MW-159		Background: HNu = 0 Rad Background is high due to proximity of U-cylinders Did not sample from 0' to 20', soil descriptions shown are taken from a similar boring at MW-159.
20–25	20.0 to 25.0	5' Continuous	2.3		Sand with Gravel (SW); light brown, moist, course grained sand, subangular gravel (15-25%) chert pebbles are present throughout the interval.		HNu = 0 Sampled from 20' to 25' due to low recovery in similar boring at MW-159.
25					From 25 ft. to 35 ft. see boring log for MW-159		

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-158 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/30/90 **FINISH** 12/07/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
							Did not sample from 25' to 35', soil descriptions shown are taken from a similar boring at MW-159.
35	35.0 to 40.0	5' Continuous	5.0		Lean Clay with Sand (CL); rounded chert gravel @ 37.5', light grey to moderate red, moist, stiff, some gravel in top 2.5'.		HNu = 0 Rad = background
40	40.0 to 45.0	5' Continuous	5.0		Sandy Lean Clay (CL); moderate red to orange, moist, firm, sand is fine grained.		HNu = 0 Rad = background
45	45.0 to 50.0	5' Continuous	2.2		Poorly Sorted Sand with Clay (SP); moderate red to orange, moist, very loose, sand is fine grained.		HNu = 0
50	50.0 to 55.0	5' Continuous	2.8		Well Sorted Sand (SW); moderate reddishbrown, wet, very loose, sand is fine grained.		HNu = 0 Sampler wet out of hole.
55	55.0 to 60.0	5' Continuous	5.0		Well Sorted Sand (SW); reddish brown to grey, wet, very loose, fine grained sand.		HNu = 0 Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-158	SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 11/30/90 **FINISH** 12/07/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	3.0		TOP 1': Same as above. Well Graded Gravel with Sand (GW); light brown to orange, wet, very loose, sands are fine, gravel is rounded.		HNu = 0 Sampler wet out of hole.
65	65.0 to 70.0	5' Continuous	1.5		TOP 1': Sand Well Graded (SW); moderate red to orange, wet. 0.5': Well Graded Gravel (GW); chert, well rounded, moderate red to light brown, very loose.		HNu = 0 Sample wet out of hole; augers were temporarily locked during drilling.
70	70.0 to 75.0	5' Continuous	3.9		Well Sorted Sand with Gravel (SW); gravel approx. 35%, chert, rounded, coarse grained to fine sands, light brown to light orange, wet very loose.		HNu = 0 Sampler wet out of hole.
75	75.0 to 80.0	5' Continuous	0.6		Well Sorted Gravel with Sand (GW); large chert pieces, well rounded, light brown to orange, wet, loose, coarse grained sand.		HNu = 0 3 in. dia. chert cobble stuck in bottom of sampler.
80	80.0 to 85.0	5' Continuous	1.5		Well Sorted Sand with Gravel (SW); light brown to orange, wet, loose, well rounded gravel, sand was coarse to fine grained.		HNu = 0 Sampler wet out of hole.
85	85.0 to 90.0	5' Continuous	1.4		Well Sorted Sand with Gravel (SW); same as above; bottom 7 in. is a well graded gravel with sand (GW).		HNu = 0 Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-158 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/30/90 **FINISH** 12/07/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	90.0 to 95.0	5' Continuous	1.4		Well Sorted Sand with Gravel (SW); same as above; bottom 0.5' is a well graded gravel with sand (GW); gravels are well rounded, sand is coarse to fine, slight amount of clay present.		HNu = 0 Sampler wet out of hole.
95	95.0 to 100.0	5' Continuous	1.1		Well Graded Sand with Gravel (SW); bottom 3 in. is Well Graded Gravel with Sand (GW); light brown to light orange, wet, well rounded gravel, fine to coarse grained sand, very loose.		HNu = 0 Sampler wet out of hole. Size of chert increasing towards bottom end of sampler.
100	100.0 to 105.0	5' Continuous	1.7		Well Graded Sand with Gravel (SW); bottom 10 in. is a Poorly Graded Gravel (GP); light brown to light orange, wet, well rounded gravel, smaller diameter than above, coarse grained sand.		HNu = 0 Sampler wet out of hole. Chert gravel up to 2.5 in. found in end of sampler.
105	105.0 to 110.0	5' Continuous	5.0		TOP 3.9': Well Graded Sand with Gravel (SW); same as above except sands are fine grained. Bottom 1.1': Well Sorted Sand (SW); highly stratified, color varies with layers - white, light brown, to orange, wet, loose, very fine grained. Total Depth = 110.0 feet		HNu= 0 Sampler wet out of hole.
110							
115							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-159 SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/28/90 **FINISH** 12/14/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.0 to 5.0	5' Continuous	1.5		Clay with Gravel (CL), gray to yellow brown, some sands, clay and sands are moist, stiff		Start drilling at 14:50 HNu = 0 Rad = background too high to get an accurate reading
5	5.0 to 10.0	5' Continuous	5.0		Clay (CL), gray to yellowish brown, moist, stiff		HNu = 0
10	10.0 to 15.0	5' Continuous	5.0		Clay (CL), light brown to gray at lower 1.5', stiff		HNu = 1 Breathing Zone = 0
15	15.0 to 20.0	5' Continuous	5.0		Clay with Sands (CL), light gray, moist, firm from 15'-18', soft from 18'-20', 15-25% sand from 18'-20', hit sand at 20', sand was an iron oxide color (moderate red)		HNu = 220 on sample at 18' Breathing Zone = 0 HNu = 500 on sample at 19.5'
20	20.0 to 25.0	5' Continuous	1.5		Sandy Clay with Gravel (CL), moderate red, wet, firm, 5-15% gravel, fine grained sand		HNu = 200 Water coming out of hole at 25' Low recovery due to gravels stuck in end of sampler See soil description of MW-158 for additional information
25	25.0 to 30.0	5' Continuous	3.0		Clayey Sand (SC/SW), moderate red with gray streaks, moist, very stiff, iron oxide layer at 27', fine grained sand		HNu = 700 on sample Sample is wet at hole

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-159 SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/28/90 **FINISH** 12/14/90 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous	5.0		Sandy Clay (CL), moderate reddish brown with gray streaks, moist, very stiff, fine grained sand		HNu = 40 ppm
35					End of boring Log		
40							
45							
50							
55							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/29/90 **FINISH** 11/30/90 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0.0 to 5.0	5' Continuous	2.4		Top 1': LEAN CLAY WITH SAND (CL); moderate reddish brown, moist, some gravel. Bottom 1.4': Lean Clay (CL); brown, moist, low plasticity, 0.25' sand seam w/ gravel.		Background: HNu=0, Rad=38cpm HNu = 0, Rad = background
5	5.0 to 10.0	5' Continuous	4.4		LEAN CLAY (CL); brown, moist, low plasticty, some mottling.		HNU = 0, Rad = background
10	10.0 to 15.0	5' Continuous	5.0		LEAN CLAY (CL); same as above except for black mottling that appears to be organic. End 0.6': Sand (SP); reddish brown, wet.		HNu = 0, Rad = background
15	15.0 to 20.0	5' Continuous	3.85		Top 0.3': LEAN CLAY WITH SAND (CL); reddish brown, wet. Middle 1.8': Lean Clay (CL); gray, wet. Bottom 1.75': Lean Clay (CL); gray, wet, with gravel grading to sand.		HNu = 0, Rad = background
20	20.0 to 25.0	5' Continuous	0		See borehole log for MW-162		Cobble in tip of sampler.
25	25.0 to 30.0	5' Continuous	3.1		FAT CLAY (CH); few to little gravel, moderately reddish brown, moist.		HNu = 0, Rad = background

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-161	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/29/90 **FINISH** 11/30/90 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous 13006	5.0		LEAN CLAY (CL); moderate reddish brown with gray mottling, moist.		HNu = 1.0 ppm, Rad = background
35	35.0 to 40.0	5' Continuous	3.7		Top 2.6': LEAN CLAY (CL); few sand, moderately reddish brown, moist. Bottom 1.1': LEAN CLAY (CL); yellowish brown, moist.		HNu = 1.0 ppm, Rad = background
40	40.0 to 44.0	5' Continuous	3.8		Top 1.4': LEAN CLAY WITH SAND (CL); gray, moist. Bottom 2.4': CLAYEY SAND (SC); moderately reddish brown with gray clay mottling, moist.		HNu = 0, Rad = background
					CLAYEY SAND (SC); moderately reddish brown with slight mottling.		HNu = 0, Rad = background
45	45.0 to 50.0	5' Continuous 13007			CLAYEY SAND (SC); same as above except gray mottling has changed to a continuous vertical member 0.5 in. x 1 in. in cross section, wet.		HNu = 5 ppm, Rad = background
50	50.0 to 55.0	5' Continuous 13008			Top 0.6': CLAYEY SAND WITH GRAVEL (SC); moderately reddish brown wet. Bottom 3.6': Sand (SP); moderately reddish brown, moist.		HNu = 10 ppm, Rad = background
55	55.0 to 60.0	5' Continuous			Top 2.2': CLAYEY SAND (SC); moderately reddish brown with gray mottling, wet. Bottom 0.4': Sand with Gravel (SW); reddish brown, wet.		HNu = 5 ppm, Rad = background Cobble in the auger

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/29/90 **FINISH** 11/30/90 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	0.8		SAND (SP); medium grained, moderately reddish brown, wet. Bottom 0.3': Gravel with Sand (GW); sand is coarse grained, moderately reddish brown, wet.		HNu = 0, Rad = background
65	65.0 to 71.0	5' Continuous	0		No recovery.		HNu = 0, Rad = background Driller notes that poor recovery is due to gravel falling out of the auger.
					No recovery. 1 piece of chert (approx. 1/Q dia.) in the end of the sampler.		
70					Total Depth = 70.0 feet		
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161A SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC 373.55 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 02/01/91 **FINISH** 02/01/91 **LOGGER** C. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY		DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
					See Soil Boring Log for MW-161 for soil description from 0' to 70'		Background: HNu=0, Rad=60cpm MW-161 was grouted and replaced by MW-161A. MW-161A was drilled 15' deeper due to difficulty in installing the well in loose sands.
5							
10							
15							
20							
25							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161A SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC 373.55 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 02/01/91 **FINISH** 02/01/91 **LOGGER** C. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35							
40							
45							
50							
55							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161A SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC 373.55 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 02/01/91 **FINISH** 02/01/91 **LOGGER** C. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
65							
70	70.0 to 75.0	5' Continuous	0.0		No recovery. 1 piece of chert (approx. 1 in. dia.) in the end of the sampler.		sampler wet; some rod chatter.
75	75.0 to 80.0	5' Continuous	0.0		No recovery.		sampler wet; slight rod chatter; sands may be too fine to stay inside sampler.
80	80.0 to 85.0	5' Continuous	1.7		Well Graded Gravel with Sand (GW); moderate red to orange, wet, loose, well rounded gravels, medium to coarse grained sands.		HNu = 0, Rad = 40 cpm sampler wet; some rod chatter.
85					Total Depth = 85.0 feet		

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-163	SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.0 to 5.0	5' Continuous	1.5		Top 1': Clayey Gravel (GC); gray, moist. Bottom 0.5': Silt (ML); gray, some organics and some large gravel, moist.		Background: HNu=0 ppm RAD=33 cpm HNu=0 RAD=background
5	5.0 to 10.0	5' Continuous 13009	5.0		Top 2.2': Silt (ML); gray, moist. Bottom 2.8': Lean Clay (CL); moderate yellowish brown with gray mottling, some organics, moist.		HNu=0 RAD=background
10	10.0 to 15.0	5' Continuous	5.0		Lean Clay (CL); Same as above.		HNu=0 RAD=background
15	15.0 to 20.0	5' Continuous	0		No Recovery.		Sample catcher in backwards.
20	20.0 to 25.0	5' Continuous	5.0		Lean Clay (CL); yellowish brown with gray mottling, moist.		HNu=0 RAD=background
25	25.0 to 30.0	5' Continuous	5.0		Top 0.5': Lean Clay (CL); Same as above. Next 0.6': Poorly Graded Sand (SP); reddish brown, moist, medium grained. Bottom 3.9': Lean Clay (CL); gray moist.		

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-163

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous	3.9		Lean Clay (CL); with trace gravel, reddish brown, moist, gravel is rounded, gray mottling. Bottom 1.6': Lean Clay (CL); with gravel, moderately reddish brown, moist, gray mottling.		HNu=0 RAD=background
35	35.0 to 40.0	5' Continuous 13010	3.8		Well Graded Gravel with Sand (GW); reddish brown, moist. Next 0.9': Poorly Graded Sand (SP); reddish brown, moist, fine grained. Bottom 2.5': Lean Clay (CL); yellowish brown with reddish brown mottling, moist.		HNu=0 RAD=background
40	40 to 45	5' Continuous	4.3		Poorly Graded Sand (SP); gray, moist, fine grained with trace coarse grains; 1.4' from top of sample there is a 0.3' seam of coarse grains.		HNu=0 RAD=background
45	45 to 50	5' Continuous	2.4		Top 2': Poorly Graded Sand (SP); with trace gravel, gray, moist, fine grained. Bottom 0.4': Lean Clay (CL); with some sand, moderate reddish brown, gray mottling, moist.		HNu=0 RAD=background
50	50 to 55	5' Continuous 13016	5.0		Top 1.2': Lean Clay (CL); with trace sand, reddish brown, gray mottling, moist. Bottom 3.8': Lean Clay (CL); reddish brown, gray mottling, moist, very stiff.		HNu=0 RAD=background
55	55 to 60	5' Continuous	2.5		Lean Clay (CL); gray with reddish brown mottling, very stiff, moist.		HNu=0 RAD=background 2.5' Slough.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-163 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	3.5		Top 0.2': Poorly Graded Sand (SP); gray, moist, medium grain size. Middle 1.75': Poorly Graded Sand (SP); reddish brown, fine grained, moist. Bottom 1.55': Poorly Graded Sand (SP); gray with reddish brown mottling, moist, coarse grained.		HNu=0 RAD=background
65	65 to 70	5' Continuous	1.3		Poorly Graded Sand (SP); moderately yellowish brown, wet, coarse grained.		HNu=0 RAD=background
70	70 to 75	5' Continuous	3.25		Top 2.25': Clayey Sand (SC); gray, moist, medium grained. Bottom 1.0': Poorly Graded Sand (SP); gray, wet, coarse grained.		HNu=0 RAD=background
75	75 to 80	5' Continuous	3.2		Poorly Graded Sand (SP); same as above except medium grained.		HNu=0 RAD=background
80	80 to 85	5' Continuous	3.5		Poorly Graded Sand (SP); same as above except coarse grained.		HNu=0 RAD=background
85	85 to 90	5' Continuous	3.0		Poorly Graded Sand (SP); same as above except with some gravels.		HNu=0 RAD=background

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-163

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	90 to 95	5' Continuous	5.0		Poorly Graded Sand (SP); same as above except no gravel.		HNu=0 RAD=background Driller indicates hitting gravel.
95	95 to 100	5' Continuous	2.0		Top 1.4': Poorly Graded Sand (SP); same as above. Bottom 0.6': Well Graded Gravel (GW); with sand, yellowish brown, moist, sand is coarse grained. Total Depth = 100.0 feet		
100							
105							
110							
115							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-165 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Plant Area, corner of Wyoming & 15th St.

ELEVATION 2" TOC 379.74 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 12/19/90 **FINISH** 01/02/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	3.9		Lean Clay (CL); light brown to light gray, moist, very stiff, small % (approx.5%) of very fine sands.		Started drilling @ 0800 Background: HNu=0 ppm, RAD=45 cpm. HNu=0, RAD=45 cpm.
5	5 to 10	5' Continuous 13000 & 13001	4.8		Lean Clay (CL); same as above.		HNu=0, RAD=background Also took sample #13001
10	10 to 15	5' Continuous	5.0		Lean Clay (CL); same as above.		HNu=0, RAD=background
15	15 to 20	5' Continuous	5.0		Lean Clay (CL); same as above.		HNu=0, RAD=background
20	20 to 25	5' Continuous	5.0		Lean Clay (CL); same as above, except for color change from light gray to gray to blueish gray		HNu=0, RAD=background
25	25 to 30	5' Continuous	5.0		Top 1.3': Lean Clay (CL); same as above. 1.8': Sandy Clay (CL); light brown to orange, moist, stiff, medium grained sand. Bottom: Lean Clay (CL); blueish gray, moist, very stiff, approx. 5% medium grained sand content.		HNu=0, RAD=background

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-165

SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Plant Area, corner of Wyoming & 15th St.

ELEVATION 2" TOC 379.74 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 12/19/90 **FINISH** 01/02/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous	5.0		Lean Clay (CL); light brown with gray streaks, moist, very stiff, approx. 3-5% medium grained sand content.		HNu=0, Rad=background
35	35 to 40	5' Continuous	4.8		Top 2.1': Lean Clay (CL); same as above. 1.5': Clayey well sorted Sand (SW); orange to moderate red, moist, stiff, medium grained sand. Bottom 1.2': Sandy Lean Clay (CL); moderate red, moist, stiff, medium grained sand.		HNu=0, RAD=background
40	40 to 45	5' Continuous	5.0		Sandy Lean Clay (CL); light brown to moderate red, moist, stiff, fine grained sands.		HNu=0, RAD=background
45	45 to 50	5' Continuous	4.0		Well sorted Sand with Clay (SW); moderate red to brown, moist, stiff, medium coarse to fine grained sand.		HNu=0, RAD=background
50	50 to 55	5' Continuous	3.6		Well sorted Sand with Clay (SW); same as above		HNu=0, RAD=background
55	55 to 60	5' Continuous	0.0		No recovery, lost sample.		HNu=0, RAD=background No recovery, sampler jamme' augers.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-165 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Plant Area, corner of Wyoming & 15th St.
ELEVATION 2" TOC 379.74 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering
DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler
WATER LEVELS **START** 12/19/90 **FINISH** 01/02/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	2.3		Well sorted Gravel with Sand (GW); light orange to light brown, wet, loose, sands are medium to fine grained, black streaking in some chert pieces.		HNu=0, RAD=background Sampler wet out of hole. Rig Chatter. Black soil in bottom of sampler approx. 1/2 in.
65	65 to 70	5' Continuous	1.6		Well sorted Gravel with Sand (GW); same as above except for black conglomerate (with chert) approx. 3 in. dia. at end of sampler.		HNu=0, RAD=background Sampler wet out of hole.
70					Total Depth = 70.0 feet		
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-168

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Diesel Spill Area, near Virgina and 10th St.

ELEVATION 2" TOC 377.42 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/20/90 FINISH 01/14/91 LOGGER D Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	2.1		Top 1.2': Lean Clay (CL); reddish brown, moist, mottling. Bottom 0.9': Lean Clay (CL); gray, moist, stiff.		Background: HNu=0 ppm, RAD=25 cpm PP = pocket penetrometer
5	5 to 10	5' Continuous 13017	4.6		Lean Clay (CL); gray, moderate reddish brown mottling, moist.		HNu=0, RAD=background
10	10 to 15	5' Continuous	5.0		Lean Clay (CL); yellowish brown, reddish brown mottling, moist.		HNu=3 ppm, RAD=background
15	15 to 20	5' Continuous	2.0		Top 1.2': Lean Clay (CL); yellowish brown, mottling, moist. Bottom 0.8': Poorly Graded Gravel (GP); with sand, brown, moist.		HNu=0, RAD=background
20	20 to 25	5' Continuous	3.4		Well Graded Sand (SW); with gravel, reddish brown, wet, sand is coarse grained.		HNu=0, RAD=background
25	25 to 30	5' Continuous 13018	5.0		Top 0.6': Well Graded Sand (SW); with gravel, same as above. Bottom 4.4': Lean Clay (CL); yellowish brown, gray mottling, moist.		HNu=0, RAD=background

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-168	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Diesel Spill Area, near Virgina and 10th St.

ELEVATION 2" TOC 377.42 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/20/90 FINISH 01/14/91 LOGGER D Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous 13019	5.0		Top 3.9': Lean Clay (CL); same as above. Bottom 1.1': Clayey Sand (SC); with gravel, moderately yellowish brown, moist.		HNu=0, RAD=background
35	35 to 40	5' Continuous	5.0		Top 1': Clayey Sand with Gravel (SC); same as above except mottling. Bottom 4': Lean Clay (CL); moderately reddish brown, moist.		HNu=couldn't get a reading RAD=background PP = 2.5 Kg/cm2
40	40 to 45	5' Continuous	5.0		Lean Clay with Sand (CL); reddish brown, wet.		HNu=no reading RAD=background PP = 1.5 Kg/cm2
45	45 to 50	5' Continuous	5.0		Lean Clay (CL); reddish brown, moist.		HNu=couldn't get a reading RAD=background PP = 1.8 Kg/cm2
50	50 to 55	5' Continuous	3.7		Clayey Sand (SC); reddish brown, moist.		HNu=0, RAD=background PP = 0.75 Kg/cm2 1.3' of slough
55	55 to 60	5' Continuous	5.0		Lean Clay with Sand (CL); moderate gray with mottling, moist.		HNu=0, RAD=background PP = 0.75 to 1.5 Kg/cm2

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-168 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Diesel Spill Area, near Virgina and 10th St.

ELEVATION 2" TOC 377.42 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/20/90 FINISH 01/14/91 LOGGER D Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY	6" -6" -6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY		DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	1.1		Poorly Graded Sand (SP); with trace gravel, moderate reddish brown, wet ------------?????----------- Well Graded Gravel (GW)		HNu=0, RAD=background Cobble in sampler. Driller thinks he was drilling in gravel.
65	65 to 70	5' Continuous	2.0		Well Graded Gravel (GW); yellowish brown-reddish brown, wet. Total Depth = 70.0 feet		HNu=0, RAD=background
70							
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-169 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION 001-Ditch, N. of C-745-C Yard

ELEVATION 2" TOC 373.41 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ START 01/02/91 FINISH 01/08/91 LOGGER B. Souza / J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous 13012	3.5		Lean Clay (CL); medium grey (N5) mottling; moist; low plasticity.		HNu=0 ppm, Rad=65 cpm. PP = pocket penetrometer
5	5 to 10	5' Continuous	0.75		Lean Clay (CL); same as above.		HNu=0 ppm, Rad=60 cpm.
10	10 to 15	5' Continuous	5.0		Lean Clay with Sand (CL); light olive brown (10YR5/6) moist, fine sand.		HNu=0 ppm, Rad=50 cpm.
15	15 to 20	5' Continuous	5.0		Sandy Lean Clay (CL); moderate reddish brown (5YR4/4) moist w/ medium gravel.		HNu=0 ppm, Rad=60 cpm.
20	20 to 25	5' Continuous	3.67		Gravel, medium Sandy Lean Clay (CL); light brown (5YR6/4) moist, fine sand.		HNu=0, Rad=45 cpm.
25	25 to 30	5' Continuous	4.5		Well Graded Sand (SW) Clayey Sand (SC)		HNu=0, Rad=55 cpm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-169 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION 001-Ditch, N. of C-745-C Yard

ELEVATION 2" TOC 373.41 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/02/91 FINISH 01/08/91 LOGGER B. Souza / J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous 13013	4.5		Well Graded Sand (SW); moderate reddish brown (10R4/6). Lean Clay (CL); dark yellowish brown (10YR6/6).		HNu=0 ppm, Rad=45 cpm. Stopped drilling for day: 1/2/91
35	35 to 40	5' Continuous	5.0		Lean Clay (CL); same as above, moist.		HNu=0=bkg, RAD=bkg=50 cpm.
40	40 to 45	5' Continuous	5.0		Lean Clay (CL); same as above, except with mottling.		HNu=0, RAD=background
45	45 to 50	5' Continuous	5.0		Lean Clay (CL); same as above except trace organics in the bottom 0.5'.		HNu=0, RAD=background Stopped drilling 1/7/91
50	50 to 55	5' Continuous	3.9		Well Graded Sand (SW); light brown (5YR5/6), wet, fine sand; turns light gray (N7) at 52'. Sandy Lean Clay (CL); moderate reddish brown (10YR4/6), mottled light gray (N7).		Started drilling 0855 1/8/91 HNu=bkg=0 ppm; RAD=bkg=50 cpm. Logger; Jim Anderson
55	55 to 60	5' Continuous	2.2		-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?- Well Graded Sand (SW); light brown (5YR5/6), wet; fine sand.		HNu=0, RAD=background Extremely wet (soupy); too soft for Pocket Pen. reading.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-169 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION 001-Ditch, N. of C-745-C Yard

ELEVATION 2" TOC 373.41 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/02/91 FINISH 01/08/91 LOGGER B. Souza / J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	2.0		Well Graded Sand (SW); same as above. -?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?-?- Well Graded Gravel with Sand (GW); moderate yellow-brown (10YR5/4), wet; subrounded gravel, medium sand.		Driller reports approx. 10 gal water in hole. HNu=0, RAD=background PP = 0 kg/cm2 Driller estimated gravel at about 61'.
65	65 to 70	5' Continuous	1.6		Well Graded Gravel with Sand (GW); same as above. Total Depth = 70.0 feet		HNu=0, RAD=background PP = 0 kg/cm2
70					Bottom of Hole 9:55 1/8/91		
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-171 SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION 001-Ditch, 100' E. of C-745-C Yard

ELEVATION 2" TOC 374.63 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/04/91 FINISH 01/04/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous 13002	3.2		Lean Clay (CL); light grey with streaks of light orange, moist, firm.		Background: HNu=0 RAD=* * = too high background Began drilling @ 1315 HNu=0 Rad=*
5	5 to 10	5' Continuous 13003	4.9		Lean Clay (CL); same as above.		HNu=0 Rad=*
10	10 to 15	5' Continuous	4.7		Lean Clay (CL); same as above except for light brown mottling.		HNu=0 Rad=*
15	15 to 20	5' Continuous 13004	3.7		Top 2.2': Lean Clay (CL); same as above Bottom 1.5': Well Graded Sand with Clay (SW); light brown to light orange, wet, firm.		HNu=0 Rad=* water @ bottom end of sampler out of hole.
20	20 to 25	5' Continuous	1.0		Well Graded Gravel with Sand (GW); light brown, wet, loose, sands are medium to coarse grained. Total Depth = 25.0 feet		HNu=0 Rad=* water out of hole.
25							

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-172	SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION 0001-Ditch, North of C-745-C Yard

ELEVATION 2" TOC 373.79 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/08/91 FINISH 01/08/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0	0 to 5	5' Continuous 13021	3.4		Lean Clay (CL); light grey with brown streaks, moist, stiff.		Background: HNu=0, Rad=45 cpm PP = pocket pentrometer HNu=0 Rad=55 cpm PP = 2Kg/cm2 Took two samples: 13005 and 13021
5	5 to 10	5' Continuous 13022	4.7		Lean Clay (CL); same as above except very stiff.		HNu=0 Rad=56 cpm PP = 3.5Kg/cm2
10	10 to 15	5' Continuous	4.6		Lean Clay (CL); same as above except for stiff.		HNu=0 Rad=59 cpm PP = 2.0Kg/cm2
15	15 to 20	5' Continuous 13023	3.8		Lean Clay with Sand (CL); light brown to moderate red, moist, stiff. Bottom 1.7': Well Graded Sand with Clay (SW); light orange to light grey, moist.		HNu=0 Rad=41 cpm PP = 1.75Kg/cm2
20	20 to 25	5' Continuous	0.6		Well Graded Gravel with Sand (GW); light brown to moderate red, wet, very loose, sands are coarse grained.		HNu=0 Rad=45 cpm
25	25 to 30	5' Continuous	4.6		Top 2': Well Graded Sand with Clay (SW); light orange, moist, stiff. Bottom: Lean Clay (CL); light grey, moist, hard. Total Depth = 30.0 feet		HNu=0 Rad=55 cpm PP = 4.25Kg/cm2

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-173 SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Upgradient of Lagoons, N. of C-746-C Yard

ELEVATION 2" TOC 373.30 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/09/91 FINISH 01/15/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous 13024	2.1		0.4': Fill Material. Lean Clay (CL); light gray with brown steaks, moist, stiff.		Background: HNu=0 ppm, Rad=25 cpm PP = pocket penetrometer HNu= 0, Rad= 25cpm PP = 1.75 Kg/cm2
5	5 to 10	5' Continuous 13025	4.9		Lean Clay (CL); same as above except for very stiff.		HNu= 0, Rad= 30cpm PP = 2.25 Kg/cm2
10	10 to 15	5' Continuous	5.0		Top 0.8': Lean Clay (CL); same as above Bottom 4.2': Silt (ML); light blueish gray, moist, hard		HNu= 0, Rad= 25cpm PP = 4.25 Kg/cm2
15	15 to 20	5' Continuous 13026	4.5		Top 0.7': Silt (ML); same as above except wet Middle 0.8': Well Graded Sand (SW); light gray to light brown, wet, loose, medium to fine grained sand Bottom 3.0': Lean Clay (CL); light gray, moist, very stiff		HNu= 0, Rad= 25cpm PP = 3.5 Kg/cm2 Sample wet out of hole.
20	20 to 25	5' Continuous	4.8		Top 0.7': Lean Clay with Sand (CL); light gray to brown, moist, very stiff, medium grained sand Bottom 4.1': Well Graded Sand with Gravel (SW); light brown, wet, loose, fine to medium grained sands		HNu= 0, Rad= 45cpm PP = 2.0 Kg/cm2 (clay)
25	25 to 30	5' Continuous	4.6		Top 2.7': Well Graded Sand with Gravel (SW); same as above Bottom 1.9': Lean Clay (CL), light gray with moderate red streaking, moist, firm		HNu= 0, Rad= 25cpm PP = 1.0 Kg/cm2 (clay) Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-173	SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Upgradient of Lagoons, N. of C-746-C Yard

ELEVATION 2" TOC 373.30 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/09/91 FINISH 01/15/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous	4.7		Lean Clay with Sand (CL); light grey to light brown, moist, very stiff, medium to fine grained sand (approx. 10%).		HNu= 0, Rad= 25cpm PP = 3.5 Kg/cm2
35	35 to 40	5' Continuous	1.3		Well Sorted Sand with Clay (SW-SC); moderate reddish orange, moist, firm, fine to medium grained sand.		HNu= 0, Rad= 25cpm Sample wet out of hole.
40	40 to 45	5' Continuous	4.5		Well Sorted Sand with Clay (SW-SC); same as above except for gray streaking		HNu= 0, Rad= 35cpm PP = 1 kg/cm2 Sample wet out of hole.
45	45 to 50	5' Continuous	4.8		Well Sorted Sand with Clay (SW-SC); same as above except for very stiff.		HNu= 0, Rad= 30cpm PP = 2.25 Kg/cm2 Sampler wet out of hole.
50	50 to 55	5' Continuous	3.7		Top 1.2': Well Sorted Sand with Clay (SW-SC); same as above Bottom 2.5': Well Sorted Sand with Gravel (SW); light brown to moderate red, moist, loose, medium grained sand, well rounded gravel (0.2" dia. max.).		HNu= 0, Rad= 30cpm Sampler wet out of hole.
55	55 to 60	5' Continuous	1.2		Well Graded Gravel (GW); moderate red, wet, loose, well rounded gravel. Total Depth = 60.0 feet		HNu= 0, Rad= 25cpm Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-175 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-47, West side of C-400 Bldg.

ELEVATION 2" TOC 381.18 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/09/91 FINISH 01/14/91 LOGGER J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous 13014	2.4		ORGANIC SOIL (OL) WELL GRADED SAND WITH CLAY AND GRAVEL (SW-SC), moderate red-brown (10R 4/6), moist		Inital attempt at drilling hit an obstruction. Offset 15 ft. south and tried again. HNu= 0 ppm Rad= 45 cpm Pocket penetrometer (PP)= 1.25 kg/sq. cm.
5	5 to 10	5' Continuous 13015	4.2		LEAN CLAY (CL), medium light gray (NG), moist, plastic		HNu= 0.5 ppm Rad= 55 cpm PP = 2.20 kg/sq. cm.
10	10 to 15	5' Continuous 13027	5.0		LEAN CLAY (CL), moderate yellow-brown (10YR 5/4), moist; trace organics; mottling medium light gray (NG)		HNu= 0 ppm Rad= 50 cpm PP = 2.75 kg/sq. cm.
15	15 to 20	5' Continuous 13028	5.0		Lean Clay (CL), same as above		HNu= 0 ppm Rad= 40 cpm PP = 3.75 kg/sq. cm.
20	20 to 25	5' Continuous 13029	2.5		WELL GRADED SAND WITH GRAVEL (SW), light brown (YR 5/6), moist; fine sand, medium subrounded gravel; trace amount of clay		HNu= 0 ppm Rad= 40 cpm PP = 1.70 kg/sq. cm.
25	25 to 30	5' Continuous 13030	2.2		POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC), moderate red-brown (10R 4/6), moist; fine sand, medium subrounded gravel		HNu= 0 ppm Rad= 50 cpm PP = 2.50 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-175 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-47, West side of C-400 Bldg.

ELEVATION 2" TOC 381.18 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/09/91 FINISH 01/14/91 LOGGER J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous 13031	2.7		LEAN CLAY WITH SAND (CL), yellowish-gray (5Y 7/2), moist; fine sand POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC), moderate red-brown (10R 4/6), moist; medium subrounded gravel		HNu= 0 ppm Rad= 40 cpm PP = 2.70 kg/sq. cm.
35	35 to 40	5' Continuous 13032	2.6				HNu= 0 ppm Rad= 55 cpm PP = 0.75 kg/sq. cm.
40	40 to 45	5' Continuous	2.5		SILT WITH SAND (ML), yellow-gray (5Y 7/2), moist; fine sand SANDY LEAN CLAY WITH GRAVEL (CL), moderate yellow-brown (10YR 5/9) mottled with medium gray (N5), moist; fine sand, fine to medium gravel; lensed with 1-3 in. poorly graded sand layers		Stopped 1/9/91 1535 Restarted 1/14/91 1300 HNu= 0 ppm Rad= 30 cpm PP = 2.5 kg/sq. cm.
45	45 to 50	5' Continuous	3.9		LEAN CLAY (CL), light brown 5YR 5/6), moist; low plasticity; 1 ft. seam of cemented fine gravel at bottom; gravel appears moderate brown (5YR 3/4), with mica		HNu= 0 ppm Rad= 40 cpm PP = 2.75-4.50 kg/sq. cm.
50	50 to 55	5' Continuous	2.7		POORLY GRADED SAND (SP), light brown (5YR 5/6), moist; fine sand		HNu= 0 ppm Rad= 55 cpm PP = 1.0-1.5 kg/sq. cm. Driller reports water at approx. 54 ft.
55	55 to 60	5' Continuous	0.9		Poorly Graded Sand (SP), same as above except wet and slightly coarser		HNu= 0 ppm Rad= 40 cpm P.P= N/A

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-175 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-47, West side of C-400 Bldg.

ELEVATION 2" TOC 381.18 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/09/91 FINISH 01/14/91 LOGGER J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	2.9		Poorly Graded Sand (SP), same as above		HNu= 0 ppm Rad= 40 cpm P.P.= N/A
65	65 to 70	5' Continuous	1.4		Poorly Graded Sand (SP), same as above		HNu= 0 ppm Rad= 40 cpm P.P.= N/A
70	70 to 75	5' Continuous	1.0		Poorly Graded Sand (SP), same as above		HNU= 0 ppm Rad= 40 cpm P.P.= N/A
75	75 to 80	5' Continuous	3.0		WELL GRADED GRAVEL WITH SAND (GW), moderate yellow-brown (10YR 5/4), wet; medium sand; fine to coarse gravel		HNu= N/A Rad= N/A P.P.= N/A
80					Total Depth = 80.0 feet Bottom of Hole reached 1/14/91 1445		
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-178 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-40, C-400 NE Corner

ELEVATION 2" TOC 378.80 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/17/91 FINISH 01/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 4	5' Continuous	0.0		No Recovery		Background: HNu=0 ppm, Rad=18 cpm PP = pocket penetrometer Fill in sampler
5	4 to 9	5' Continuous	0.0		No Recovery		Fill in sampler
10	9 to 14	5' Continuous 13020	4.5		Lean Clay (CL), yellowish brown with mottling, moist		HNu=0 ppm, Rad=background PP = 2.25 to 3.0 Kg/cm2 0.5' of fill
15	14 to 19	5' Continuous 13034	4.8		Top 4.0': Lean Clay (CL), same as above Bottom 0.8': Clayey Sand (SC), yellowish brown, moist, medium grained sand		HNu=0 ppm, Rad=background PP = 2.0 Kg/cm2
20	19 to 24	5' Continuous 13035	4.6		Top 3.4': Lean Clay (CL), medium gray with mottling, moist Bottom 1.2': Well Graded Sand (SW), brownish red, moist		HNu=0 ppm, Rad=background PP = 2.0 Kg/cm2 for clay
25	24 to 29	5' Continuous 13036	2.0		Poorly Graded Sand (SP), with trace gravel, reddish brown, moist		HNu=0 ppm, Rad=background

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-178 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-40, C-400 NE Corner

ELEVATION 2" TOC 378.80 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/17/91 FINISH 01/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
			5.0		Lean Clay (CL), with sand, medium gray, moist, fine grained sand		HNu=0 ppm, Rad=background PP > 4.5 Kg/cm2
35	34 to 39	5' Continuous 13038	2.8		Lean Clay (CL), with sand, same as above except with trace gravel		HNu=0 ppm, Rad=background PP = 4.2 Kg/cm2
40	39 to 44	5' Continuous	5.0		Lean Clay (CL), medium gray, reddish brown, moist		HNu=0 ppm, Rad=backgroun PP = 1.2 to 2.0 Kg/cm2
45	44 to 49	5' Continuous	5.0		Lean Clay (CL), reddish brown with black staining, moist		HNu=0 ppm, Rad=background PP = 2.0 Kg/cm2 (top) PP = 4.5 Kg/cm2 (bottom)
50	49 to 54	5' Continuous	0.0		No Recovery		HNu=0 ppm, Rad=background Slough
55	54 to 59	5' Continuous	2.4		Well Graded Sand (SW), reddish brown, wet, medium grained sand		HNu=0 ppm, Rad=background Cobble in sampler Driller reports hitting a hard object at 58'

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-178 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-40, C-400 NE Corner

ELEVATION 2" TOC 378.80 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/17/91 FINISH 01/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
			2.1		Well Graded Gravel (GW), yellowish brown, wet		HNu=0 ppm, Rad=background Cobble in sampler
65	64 to 69	5' Continuous	1.5		Poorly Graded Gravel (GP), with sand, yellowish brown, wet		HNu=0 ppm, Rad=background
70							
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
OR030888.FI	MW-179 SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill- N. Side

ELEVATION 2" TOC 358.60 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME rig; 3 3/4" O.D. Auger; 5'x3' I.D. Sampler

WATER LEVELS **START** 2/1/91 **FINISH** 2/4/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY		DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
					No samples taken above depth of 40 ft. See H-219 for lithology from 0-40ft.		
5							
10							
15							
20							
25							

PROJECT NUMBER	BORING NUMBER
OR030888.FI	MW-179 SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill- N. Side

ELEVATION 2" TOC 358.60 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME rig; 3 3/4" O.D. Auger; 5'x3' I.D. Sampler

WATER LEVELS ____ **START** 2/1/91 **FINISH** 2/4/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35							
40	40 to 45	5' Continuous	1.0		CLAYEY SAND WITH GRAVEL, (SP), yellowish-brown, wet sand-medium grained		P.P.= Pocket Pentrometer HNu= 0 ppm= Background Rad= 27 cpm= Background P.P.= N/A Gravels in sample catcher
45	45 to 50	5' Continuous	1.0		POORLY GRADED SAND, (SP), yellowish-brown, wet, medium-coarse grained		HNu= Background Rad= Background P.P.= N/A
50	50 to 55	5' Continuous	1.5		WELL GRADED SAND, (SW), yellowish-brown, wet, with gravels, sand-medium to coarse grained		HNu= Background Rad= Background P.P.=N/A
55	55 to 59	5' Continuous	1.5		WELL GRADED SAND, (SW), Same as above		HNu= Background Rad= Background P.P.= N/A

PROJECT NUMBER	BORING NUMBER	
OR030888.FI	MW-180A	SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill-N. Side

ELEVATION 2" TOC 358.11 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT 75 CME rig; 3/4" O.D. Auger; 5'X3' I.D. Sampler

WATER LEVELS **START** 1/31/91 **FINISH** 1/31/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	2.5		LEAN CLAY, (CL), yellowish brown, mottling, moist, hard		P.P.= Pocket Penetrometer HNu= 0ppm=BKG RAD= 33 cpm=BKG P.P. =4.25->4.50 5' Slough
5	5 to 10	5' Continuous	4.8		Top 7' LEAN CLAY, (CL), with sand, brown, wet, soft Bottom 4.1' LEAN CLAY, (CL), Bottom portion with sand and gravel, hard, moist		HNu= BKG RAD= BKG P.P.= 0.25-Top 4.0->4.5
10	10 to 15	5' Continuous	3.4		Top 2.4'- LEAN CLAY, (CL), with sand and gravel, same as above Bottom 1.0'-POORLY GRADED SAND, (SP), yellowish brown, moist-wet, sand-medium grained		HNu= BKG RAD= BKG P.P.= 3.75-4.0 (clay)
15	15 to 20	5' Continuous	5.0		Top 1.4'- LEAN CLAY, (CL), moderate reddish brown, moist, hard Bottom 3.6'- LEAN CLAY, (CL), with sand, gray, moist		HNu= BKG RAD= BKG P.P.= 3.25-4.25
20	20 to 25	5' Continuous	4.5		LEAN CLAY, (CL), with sand, moderate reddish brown, bottom 2.0' contains more moisture than top 2.5'		HNu= BKG RAD= BKG P.P.=3.25-Top 1.50-Bottom
25	25 to 30	5' Continuous	5.0		Top 1.5'- LEAN CLAY, (CL), with sand, reddish brown, moist-wet, soft-firm Bottom 3.5'- LEAN CLAY, (CL), Same as above except moist and very stiff		HNu= BKG RAD= BKG P.P.= 0.5-1.5 Top 3.0-4.25 Botto This borehole was for stratigraphy only. It was grouted from 30' to ground surface.

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-181	SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North Landfill, South side

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ START 02/06/91 FINISH 02/11/91 LOGGER L. Kieffe

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.0 to 5.0	5' Continuous	1.3		Lean Clay with Gravel (CL), moderate yellowish brown, moist		Background: OVA=0 ppm, Rad=30 cpm PP = pocket penetrometer OVA=0, Rad=background PP = 1.3 Kg/cm2
5	5.0 to 10.0	5' Continuous	3.3		Lean Clay with Gravel (CL), medium gray, moist		OVA=0, Rad=70 cpm PP = 1.25 Kg/cm2
10	10.0 to 15.0	5' Continuous	5.0		Sandy Lean Clay (CL), light gray, moist		OVA=0, Rad=background PP = 2.5 Kg/cm2
15	15.0 to 20.0	5' Continuous	5.0		Sandy Lean Clay (CL), moderate yellowish brown, moist		OVA=0, Rad=background PP = 2.4 Kg/cm2
20	20.0 to 25.0	5' Continuous	5.0		Top 3.0': Sandy Lean Clay (CL), moderate yellowish brown, moist Bottom 2.0': Poorly Graded Sand with Gravel (SP), light brown, moist		OVA=0, Rad=background PP = 3.5 Kg/cm2
25	25.0 to 30.0	5' Continuous	5.0		Top 0.5': Sandy Lean Clay (CL), light brown, moist Bottom 4.5': Lean Clay (CL), light brown, moist		OVA=0, Rad=background PP = 1.6 to 2.3 Kg/cm2

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-181	SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North Landfill, South side

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ START 02/06/91 FINISH 02/11/91 LOGGER L. Kieffe

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous	5.0		Lean Clay (CL), moderate yellowish brown, moist, hard		HNu=0, RAD=28 cpm PP > 4.5 Kg/cm2
35	35.0 to 40.0	5' Continuous	5.0		Top 3.0': Lean Clay (CL), same as above Bottom 2.0': Sandy Lean Clay (CL), medium gray, moist, hard		HNu=0, RAD=background PP > 4.5 Kg/cm2 (top) PP = 4.25 Kg/cm2 (bottom)
40	40.0 to 45.0	5' Continuous	2.2		Poorly Graded Sand (SP), moderate reddish brown, moist, fine grained sand		HNu=0, RAD=background PP = N/A
45	45.0 to 50.0	5' Continuous	2.3		Poorly Graded Sand (SP), same as above except sand is medium grained and wet		HNu=0, RAD=background PP = N/A Gravels in sample catcher
50	50.0 to 55.0	5' Continuous	0.0		No Recovery, sample fell out		No sample catcher used.
55	55.0 to 60.0	5' Continuous	1.5		Well Graded Sandy Gravel (GW), moderate yellowish brown, wet, medium to coarse grained sand		HNu=0, RAD=background PP = N/A Gravels in sample catcher

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-183	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-8, Sanitary Landfill

ELEVATION ______ **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 11/24/90 **FINISH** 01/29/91 **LOGGER** G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.0 to 5.0	5' Continuous	1.4		0.4': Fill Material 1.0': Lean Clay (CL); dark brown, moist, very stiff, some plant roots and gravel.		Background: HNu=0 Rad=21 cpm PP = pocket penetrometer HNu=0, Rad=29cpm, pp=3.25Kg/cm2 for CL.
5	5.0 to 10.0	5' Continuous	0.4		Fill Material; pieces of wood, black, moist.		HNu=0, Rad=35cpm, pp=N/A; low recovery due to wood chips stuck in end.
10	10.0 to 15.0	5' Continuous 13061	2.9		Top 0.5': Well Graded Gravel with Sand (GW); light brown, wet, loose, coarse sand, some wood chips. Bottom 2.4': Lean Clay (CL); dark brown, moist, stiff.		HNu=0, Rad=31cpm, pp=2.0Kg/cm2 for CL. Bottom of sampler wet out of hole.
15	15.0 to 20.0	5' Continuous 13062	5.0		Lean Clay (CL); same as above.		HNu=0, Rad=34cpm, pp=2.0Kg/cm2 for CL. Sampler wet out of hole. Took two samples: 13062 and 13063
20	20.0 to 25.0	5' Continuous	5.0		Lean Clay (CL); same as above.		HNu=0, Rad=29cpm, pp=2.0Kg/cm2.
25	25.0 to 30.0	5' Continuous	3.5		Lean Clay (CL); same as above except for dark yellowish orange striations, very stiff.		HNu=0, Rad=27cpm, pp=3.5Kg/cm2. Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-183 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-8, Sanitary Landfill

ELEVATION ______ **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 11/24/90 **FINISH** 01/29/91 **LOGGER** G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous	5.0		Lean Clay (CL); light gray with light orange layering, moist, brittle, very stiff, fairly blocky.		HNu=0, Rad=32cpm, pp=3.75Kg/cm2. Sampler wet out of hole.
35	35.0 to 40.0	5' Continuous	4.2		Lean Clay (CL); same as above.		HNu=0, Rad=30cpm, pp=3.75Kg/cm2. Sampler wet out of hole.
40	40.0 to 45.0	5' Continuous	5.0		Lean Clay (CL); grayish black, moist, hard, fissured.		HNu=0, Rad=38cpm, pp=4.5Kg/cm2. Sampler wet out of hole.
45	45.0 to 50.0	5' Continuous	5.0		Lean Clay (CL); same as above except highly fissured and brittle, micaceous		HNu=0, Rad=38cpm, pp=4.5Kg/cm2. Sampler wet out of hole.
50	50.0 to 55.0	5' Continuous	5.0		Lean Clay (CL); same as above except dry.		HNu=0, Rad=45cpm, pp=4.5Kg/cm2.
55	55.0 to 60.0	5' Continuous	5.0		Lean Clay (CL); same as above		HNu=0, Rad=41cpm, pp=4.5Kg/cm2.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-183 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-8, Sanitary Landfill

ELEVATION **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 11/24/90 **FINISH** 01/29/91 **LOGGER** G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	5.0		Lean Clay (CL); grayish black, dry, hard, highly fissured, micaceous.		HNu=0, Rad=32cpm, pp=4.0Kg/cm2. Sampler wet out of hole.
65	65.0 to 70.0	5' Continuous	5.0		Lean Clay (CL); same as above.		HNu=0, Rad=35cpm, pp=4.25Kg/cm2.
70					Total Depth = 70.0 feet		
75							
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-185 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-7 Burial Ground

ELEVATION 2" TOC 373.64 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/17/91 **FINISH** 01/23/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	1.3		Top 0.4': Gravel fill material SILT (ML), light gray, moist, firm		Background: HNu=0 Rad=29 cpm PP = pocket penetrometer HNu= 0 ppm Rad= 38 cpm PP = 1.75 kg/sq. cm. Rod chatter
5	5 to 10	5' Continuous 13040	4.3		Top 2.1': SILT (ML), Same as above Bottom 2.2': LEAN CLAY (CL), light brown with gray streaking, moist, very stiff		HNu= 0 ppm Rad= 30 cpm PP = 2.25 kg/sq. cm.
10	10 to 15	5' Continuous	4.7		LEAN CLAY (CL), Same as above		HNu= 0 ppm Rad= 40 cpm PP = 2.25 kg/sq. cm.
15	15 to 20	5' Continuous 13041	4.7		Top 4.2': LEAN CLAY (CL), Same as above Bottom 0.5': WELL GRADED SAND (SW), light gray, orange mottling, wet, loose, medium grained sand		HNu= 0 ppm Rad= 30 cpm PP = 2.25 kg/sq. cm. for CL
20	20 to 25	5' Continuous	4.8		Top 2.8': WELL GRADED SAND (SW), Same as above Bottom 2': LEAN CLAY WITH GRAVEL (CL), moderate red to gray, moist, very stiff, rounded gravel		HNu= 0 ppm Rad= 33 cpm PP = 3.1 kg/sq. cm.
25	25 to 30	5' Continuous	5.0		Top 1.0': WELL SORTED GRAVEL WITH CLAY (GW), moderate red, moist, stiff, well rounded gravel Bottom 4.0': LEAN CLAY WITH SAND (CL), moderate red to gray, moist, hard		HNu= 0 ppm Rad= 43 cpm PP = 4.50 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER	
ORO 30888.FI	MW-185	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-7 Burial Ground

ELEVATION 2" TOC 373.64 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/17/91 **FINISH** 01/23/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous	4.9		LEAN CLAY WITH SAND (CL), moderate red to grey, moist, hard, medium to fine grained sand		HNu= 0 ppm Rad= 30 cpm PP = 4.5 kg/sq. cm.
35	35 to 40	5' Continuous 13042	4.8		LEAN CLAY WITH SAND, (CL) Same as above		HNu= 0 ppm Rad= 29 cpm PP = 4.25 kg/sq. cm.
40	40 to 45	5' Continuous	3.0		Top 1.9': LEAN CLAY WITH SAND (CL), Same as above, except very stiff Bottom 1.1': WELL GRADED SAND (SW), light brown, moist, loose, fine to medium grained sand		HNu= 0 ppm Rad= 41 cpm PP = 3.0 kg/sq. cm.
45	45 to 50	5' Continuous	5.0		Top 3.5': LEAN CLAY (CL), dark brown, moist, very stiff Bottom 1.5': WELL SORTED SAND WITH CLAY (SW-SC), light gray with black streaking, moist, soft		HNu= 0 ppm Rad= 38 cpm PP = 3.5 kg/sq. cm. for CL PP = 0.5 kg/sq. cm. for SW-SC
50	50 to 55	5' Continuous	4.8		Top 1.7': WELL SORTED SAND WITH CLAY (SW-SC), Same as above Middle 0.4': WELL GRADED SAND (SW), black to dark gray, moist, loose Bottom 2.7': LEAN CLAY WITH SAND (CL), dark brown with gray streaks, moist, very stiff, fine grained sands		HNu= 0 ppm Rad= 37 cpm PP = 2.5 kg/sq. cm. for CL
55	55 to 60	5' Continuous	3.8		Top 1.9': LEAN CLAY WITH SAND (CL), Same as above, except firm Bottom 1.9': WELL SORTED SAND (SW), light brown to moderate red, wet, very loose		HNu= 0 ppm Rad= 34 cpm PP = 0.75 kg/sq. cm. for CL

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-185 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-7 Burial Ground

ELEVATION 2" TOC 373.64 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/17/91 **FINISH** 01/23/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	5.0		Top 4.0': WELL GRADED SAND (SW), light brown, wet, very loose Bottom 1.0': WELL GRADED SAND WITH GRAVEL (GW), light brown to moderate red, wet, loose, well rounded gravel, medium grained sands		HNu= 0 ppm Rad= 38 cpm PP = N/A Sampler wet out of hole
65	65 to 70	5' Continuous	1.4		WELL GRADED GRAVEL WITH SAND (GW), Same as above, except larger chert pieces (approx. 2 in. diameter maximum)		HNu= 0 ppm Rad= 36 cpm P.P.= N/A Sampler wet out of hole
70	70 to 75	5' Continuous	2.0		WELL GRADED GRAVEL WITH SAND (GW) Same as above		HNU= 0 ppm Rad= 38 cpm PP = N/A Sampler wet out of hole
75					Total Depth = 75.0 feet		
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-187 SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-30, Burn Area, with MW-66

ELEVATION 2" TOC 373.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/17/91 **FINISH** 01/17/91 **LOGGER** J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	3.4		GRAVEL DRILL PAD LEAN CLAY WITH GRAVEL (CL), dark yellow-brown (10YR 4/2), moist; 0.4' thick POORLY GRADED GRAVEL WITH SAND (GP) seam at approximately 2'. Clay grades to medium gray (N5) at approximately 2.5'.		Background: HNu= 0 ppm Rad= 40 cpm PP = pocket penetrometer HNu= 0 ppm Rad= 130 cpm
5	5 to 10	5' Continuous 13043	4.9		LEAN CLAY (CL), moderate yellow brown mottled with light olive gray (10YR 5/4 mottled 5YG/I), moist		HNu= 0 ppm Rad= 70 cpm PP = 0.7 to 2.3 kg/sq. cm.
10	10 to 15	5' Continuous	4.9		LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= 60 cpm PP = 1.7 to 4.1 kg/sq. cm. Driller reports water at 14 ft.
15	15 to 20	5' Continuous 13044	4.9		LEAN CLAY (CL), same as above, but with increased silt content, and wet. Seam of LEAN CLAY (CL), dark yellow-brown mottled with pale yellow-brown (10YR 6/2), wet		HNu= 10 ppm Rad= 40cpm PP = 2.5 to >4.5 kg/sq. cm.
20	20 to 25	5' Continuous	2.5		-----?--------------?----------- WELL GRADED SAND WITH GRAVEL (SW), pale yellow-brown (10YR 6/2), wet; trace clay POORLY GRADED SAND (SP), light brown, wet, trace amount of clay		HNu= 0 ppm Rad= 50 cpm PP = 0.4 to 3.2 kg/sq. cm.
25	25 to 30	5' Continuous	4.7		LEAN CLAY (CL), moderate yellow-brown mottled with light olive gray (10YR 5/4) mottled 5Y 6/1) from 28-29', moist		HNu=9 ppm Rad= 65 cpm PP = 3.9 to >4.5 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-187 SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-30, Burn Area, with MW-66

ELEVATION 2" TOC 373.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 01/17/91 **FINISH** 01/17/91 **LOGGER** J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
30–35	30 to 35	5' Continuous	4.7		LEAN CLAY (CL), same as above, except 0.4' seam SILT (ML), moderate brown from 33.5-34' POORLY GRADED SAND (SP), pale yellow-brown (10 YR 6/2), wet		HNu= 7 ppm Rad= 45 cpm PP = 4.3 to >4.5 kg/sq. cm.
35–40	35 to 40	5' Continuous	4.8		LEAN CLAY (CL), light brown gray (5 YR 6/1), moist; 0.3' POORLY GRADED SAND (SP) seam from 38-38.5'		HNu= 5 ppm Rad= 50 cpm PP = 2.7 to >4.5 kg/sq. cm.
40					Total Depth = 40.0 feet Bottom of Hole reached 1/17/91 1355		
45							
50							
55							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-188 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, SW of Oil Landform

ELEVATION 2" TOC 374.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/22/91 **FINISH** 01/23/91 **LOGGER** B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0 to 5	5' Continuous	1.5		WELL GRADED GRAVEL (FILL) LEAN CLAY (CL), dark yellowish orange 10YR 6/6, moist		PP = pocket penetrometer HNu= 0 ppm Rad= 50 cpm PP = 2.0 to 2.5 kg/sq. cm.
5	5 to 10	5' Continuous 13047 & 13048	4.7		LEAN CLAY (CL), light olive gray 5Y 6/1, moist		HNu= 0 ppm Rad= 65 cpm PP = 0 to 2 kg/sq. cm. Took two samples: 13047 and 13048
10	10 to 15	5' Continuous	3.9		SANDY LEAN CLAY (CL), moderate yellowish brown 10YR 5/4, fine sand		HNU= 0 ppm Rad= 80 cpm PP = 1 to 2.7 kg/sq. cm.
15	15 to 20	5' Continuous 13049	3.5		SANDY LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= 45 cpm PP = 1 to 1.9 kg/sq. cm.
20	20 to 25	5' Continuous	4.0		SANDY LEAN CLAY (CL), light brown 5 YR 5/6, moist, fine sand, medium gravel		HNu= 0 ppm Rad= 50 cpm PP = 1.7 to 3.0 kg/sq. cm.
25	25 to 30	5' Continuous	4.5		SANDY LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= 60 cpm PP = 2.0 to 2.5 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-188 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, SW of Oil Landform

ELEVATION 2" TOC 374.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/22/91 **FINISH** 01/23/91 **LOGGER** B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 to 35	5' Continuous	4.5		LEAN CLAY (CL), light brown 5YR 5/6, moist, fine sand SANDY LEAN CLAY (CL), dark yellowish orange 10 YR 6/6		HNu= 0 ppm Rad= 65 cpm PP = 1 to 2.5 kg/sq. cm.
35	35 to 40	5' Continuous	5.0		LEAN CLAY (CL), dark yellowish brown 10 YR 6/6 mottling with bluish grey 5B 7/1		HNu= 0 ppm Rad= 50 cpm PP = 1 to 2.5 kg/sq. cm.
40	40 to 45	5' Continuous	1.5		LEAN CLAY WITH SAND LENSE (CL), light brown 5 YR 5/6 mottling		HNu= 0.5 ppm Rad= 60 cpm
45	45 to 50	5' Continuous	5.0		SANDY CLAY (SC), moderately reddish brown 10YR 4/6 mottling with light gray sand 6N 6		HNu= 1.0 ppm Rad= 65 cpm PP = 2.0 kg/sq. cm.
50	50 to 55	5' Continuous	4.5		SANDY CLAY (SC), light brown 5 YR 5/6, slightly moist, mottling from 50 to 53 feet.		HNu= 0 ppm Rad= 60 cpm PP = 1.0 kg/sq. cm.
55	55 to 60	5' Continuous	5.0		SANDY CLAY (CL), with numerous sand lenses and fractures, light grey N7		HNu= 0 ppm Rad= 70 cpm PP = 2.75 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-188 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, SW of Oil Landform

ELEVATION 2" TOC 374.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/22/91 **FINISH** 01/23/91 **LOGGER** B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60 to 65	5' Continuous	3.0		SANDY CLAY (SC), light grey, N7 mottling very moist SILTY SAND (SM), dark yellowish orange 10 YR 6/6		HNu= 0 ppm Rad= 70 cpm PP = 0.75 kg/sq. cm.
65	65 to 70	5' Continuous	2.5		SILTY GRAVEL (GM), subangular and subrounded, several 2 in. subangular stones, poorly sorted, saturated dark yellowish orange 10 YR 6/6		HNu= 0 ppm Rad= 55 cpm PP = N/A
70	70 to 75	5' Continuous	2.0		SILTY GRAVEL (GM) Dark yellowish orange 10 YR/6/6. Poorly sorted, saturated		HNu= 0 ppm Rad= 45 cpm PP = N/A
75					Total Depth = 75.0 feet		
80							
85							

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-190 SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North of Classified Burial Yard

ELEVATION ______ **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ______ **START** 01/18/91 **FINISH** 01/18/91 **LOGGER** J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0–5	0 to 5	5' Continuous	4.0		GRAVEL DRILL PAD LEAN CLAY (CL), moderate yellow brown (10YR 5/4) mottled with medium gray (N5), moist, grades to a solid medium gray (N5), very soft, at 4'		Background: HNu=0 ppm, Rad=40 cpm PP = pocket penetrometer HNu=0.5 ppm, Rad=65 cpm PP = 0 to 3.5 Kg/cm2
5–10	5 to 10	5' Continuous 13039	5.0		LEAN CLAY (CL), moderate yellow brown (10YR 5/4) mottled light olive gray (5Y 6/1), moist, stained throughout with brown black (5YR 2/1), apparently organic material		HNu=3 ppm, Rad=45 cpm PP = 0.5 to 1.5 Kg/cm2
10–15	10 to 15	5' Continuous	4.8		LEAN CLAY (CL), same as above but with no staining		HNu=5 ppm, Rad=55 cpm PP = 1.0 to 2.2 Kg/cm2 Driller reports water at 13'
15–20	15 to 20	5' Continuous 13046	3.9		LEAN CLAY (CL), same as above but with increased silt content and wet POORLY GRADED SAND WITH GRAVEL (SP), light brown (5YR 5/6), wet, with clay		HNu=8 ppm, Rad=50 cpm PP = 1.4 to 4.4 Kg/cm2 Driller reports sand at 19'
20–25	20 to 25	5' Continuous	1.1		POORLY GRADED SAND WITH GRAVEL (SP), same as above		HNu=9 ppm, Rad=35 cpm PP = N/A (granular) Driller notes clay at 24'
25					Bottom of Hole Reached 1/8/91 at 1102		

PROJECT NUMBER	BORING NUMBER
ORO 30888.FS	H-219 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill, N side, on pad with MW-179&180

ELEVATION **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/24/91 **FINISH** 01/29/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.0 to 5.0	5' Continuous 13067	3.5		LEAN CLAY (CL), yellowish brown, moist		Background: HNu= 0 ppm Rad= 33 cpm PP = pocket penetrometer HNu= 0 ppm Rad= 33 cpm PP = 4.50 kg/sq. cm.
5	5.0 to 10.0	5' Continuous 13068	5.0		LEAN CLAY (CL), with sand, moderate gray, moist		HNu= 0 ppm Rad= background PP = 3.25 kg/sq. cm.
10	10.0 to 15.0	5' Continuous 13060	4.3		CLAYEY SAND (SC), moderate gray with some reddish brown mottling, moist		HNu= 0 ppm Rad= background PP = 3.50 kg/sq. cm.
15	15.0 to 20.0	5' Continuous 13065	3.6		CLAYEY SAND (SC), same as above except more mottling		HNu= 0 ppm Rad= background PP = 2.25 kg/sq. cm.
20	20.0 to 25.0	5' Continuous 13066	5.0		LEAN CLAY (CL), moderate gray with mottling, moist		HNu= 0 ppm Rad= background PP = 4.25 kg/sq. cm.
25	25.0 to 30.0	5' Continuous 13059	5.0		CLAYEY SAND (SC), reddish brown, wet, fine grained sand		HNu= 0 ppm Rad= background PP = 2.25 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FS	H-219 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill, N side, on pad with MW-179&180

ELEVATION **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/24/91 **FINISH** 01/29/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 to 35.0	5' Continuous 13058	5.0		LEAN CLAY (CL), reddish brown, moist		HNu= 0 ppm Rad= background PP = 2.75 kg/sq. cm.
35	35.0 to 40.0	5' Continuous 13070	5.0		LEAN CLAY (CL), with sand, moderate reddish brown, moist		HNu= 0 ppm Rad= background PP = 2.75 kg/sq. cm.
40	40.0 to 45.0	5' Continuous 13080	4.6		LEAN CLAY (CL), yellowish brown, wet, some gravel		HNu= 0 ppm Rad= background PP = 0.0 kg/sq. cm.
45	45.0 to 50.0	5' Continuous 13083	1.0		POORLY GRADED SAND (SP), yellowish brown, wet, with gravel		HNu= 0 ppm Rad= background PP = N/A rocks in sample catcher
50	50.0 to 55.0	5' Continuous 13084	1.0		POORLY GRADED SAND (SP), with gravel, same as above		HNu= 0 ppm Rad= background PP = N/A gravels in sample catcher
55	55.0 to 60.0	5' Continuous	0.5		WELL GRADED SAND (SW), with gravel, same as above		HNu= 0 ppm Rad= background P.P= N/A gravels in sample catcher

PROJECT NUMBER	BORING NUMBER
ORO 30888.FS	H-219 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill, N side, on pad with MW-179&180

ELEVATION **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/24/91 **FINISH** 01/29/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	1.2		POORLY GRADED SAND (SP), moderately yellowish brown, wet, some gravel		HNu= 0 ppm Rad= background P.P.= N/A large gravel in catcher
65	65.0 to 70.0	5' Continuous	1.3		POORLY GRADED SAND (SP), same as above		HNu= 0 ppm Rad= background P.P.= N/A large gravel in catcher
70	70.0 to 75.0	5' Continuous 13081	4.7		LEAN CLAY (CL), moderate clay, moist		HNU= 0 ppm Rad= background P.P.= 1.0 to 2.75 kg/cm sq. Took two samples: 13081 and 13082
75	75.0 to 80.0	5' Continuous	2.5		LEAN CLAY (CL), same as above except iron stained layers		HNu= 0 ppm Rad= background P.P.= 0.5 kg/cm sq. 0.5' of slough
80	80.0 to 85.0	5' Continuous	5.0		LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= background PP = 0.75 kg/cm sq.
85	85.0 to 90.0	5' Continuous 13087	5.0		LEAN CLAY (CL), same as above except little to no staining		HNu= 0 Rad= background PP = 1.0 kg/cm sq.

PROJECT NUMBER	BORING NUMBER
ORO 30888.FS	H-219 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** North Landfill, N side, on pad with MW-179&180

ELEVATION ______ **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

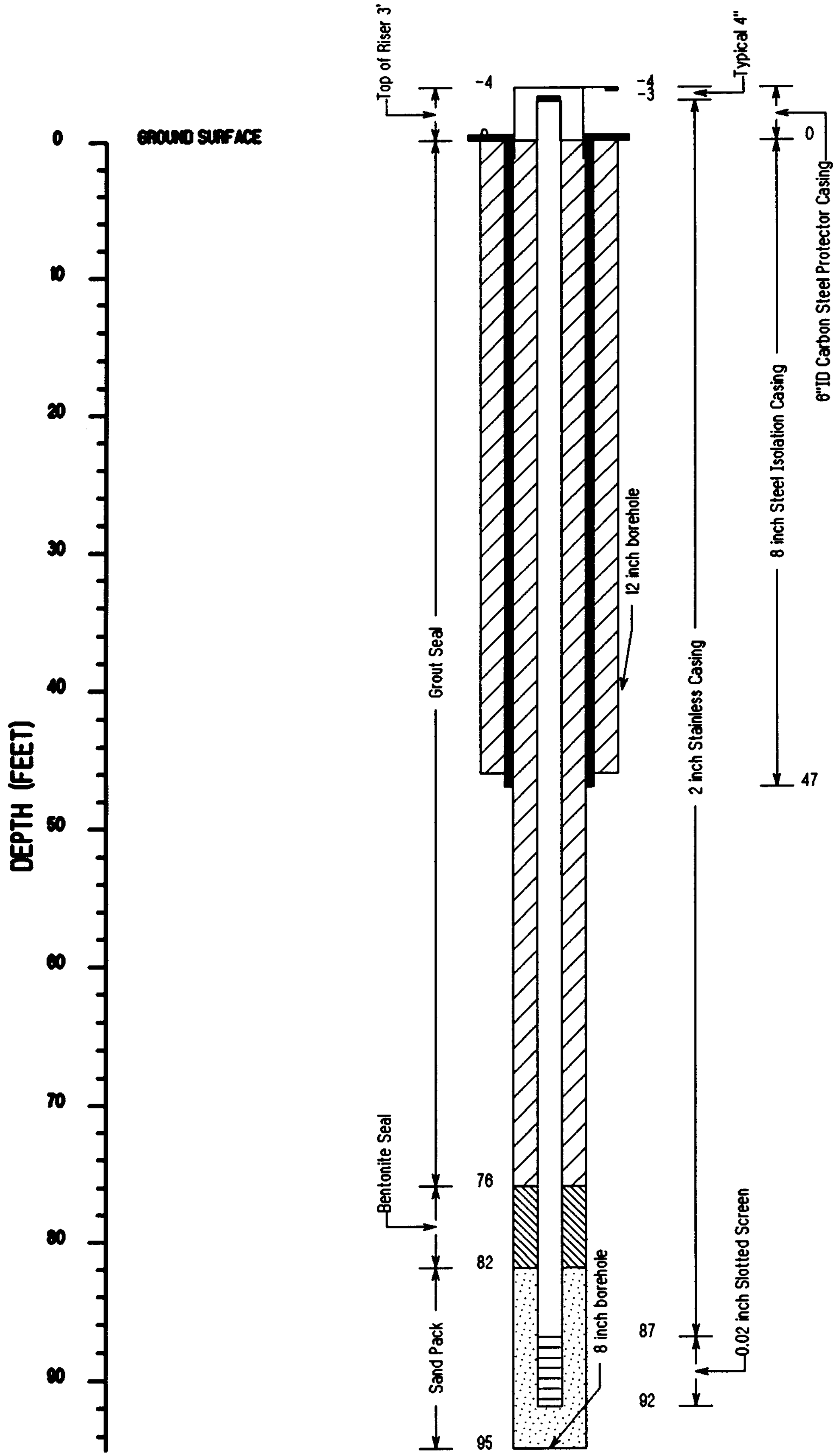
WATER LEVELS ______ **START** 01/24/91 **FINISH** 01/29/91 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90.0 to 95.0	5' Continuous	3.3		Top 1.8': LEAN CLAY (CL), with sand, moderate gray, wet, fine grained sand. Bottom 1.5': LEAN CLAY (CL), laminated dark gray, moderate gray, and iron staining, moist		HNu= 0 Rad= background PP = 2.0 kg/cm sq. (bottom)
95					Total Depth= 95ft. below ground surface		
100							
105							
110							
115							

Attachment 4-C

Well Construction Diagrams

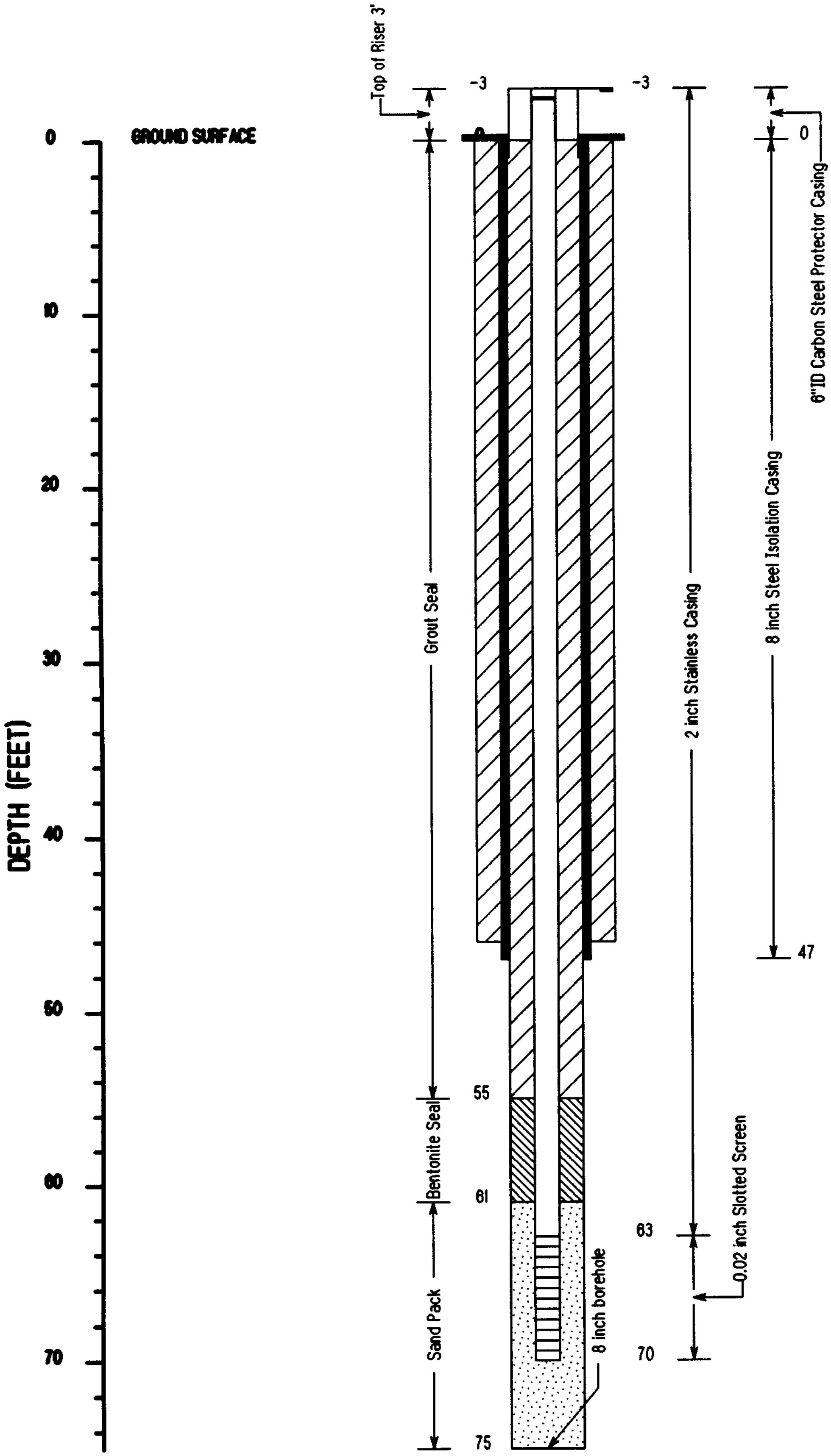
(See Logbook # 19)



WELL CONSTRUCTION DETAILS
WELL MW-155
ELEVATION: 2" TOC 381.25 ft. MSL

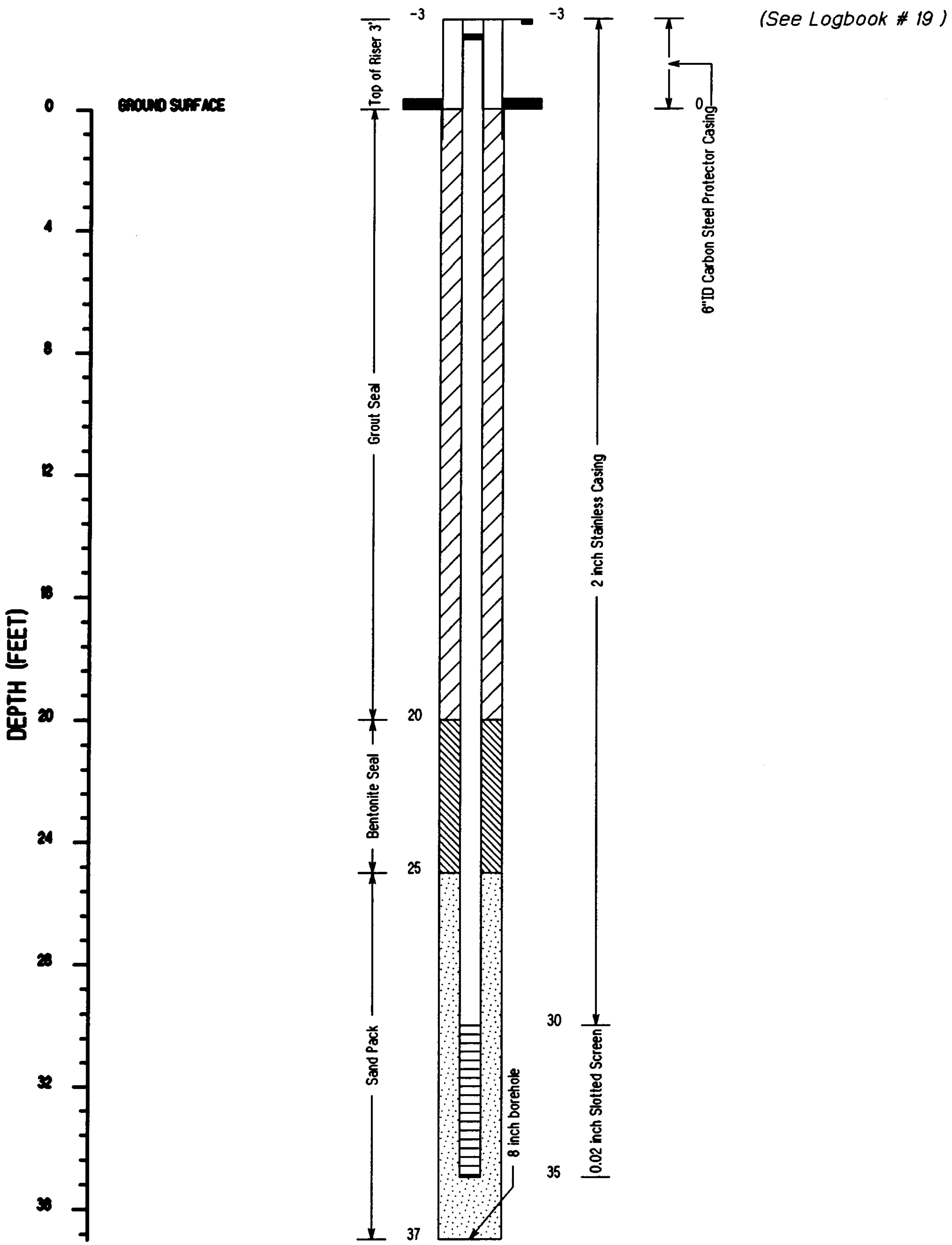
PGDP Phase II Site Investigation
S.E. Corner of C-400 Building

(See Logbook # 19)



WELL CONSTRUCTION DETAILS
WELL MW-158
ELEVATION: 2" TOC 382.06 ft. MSL

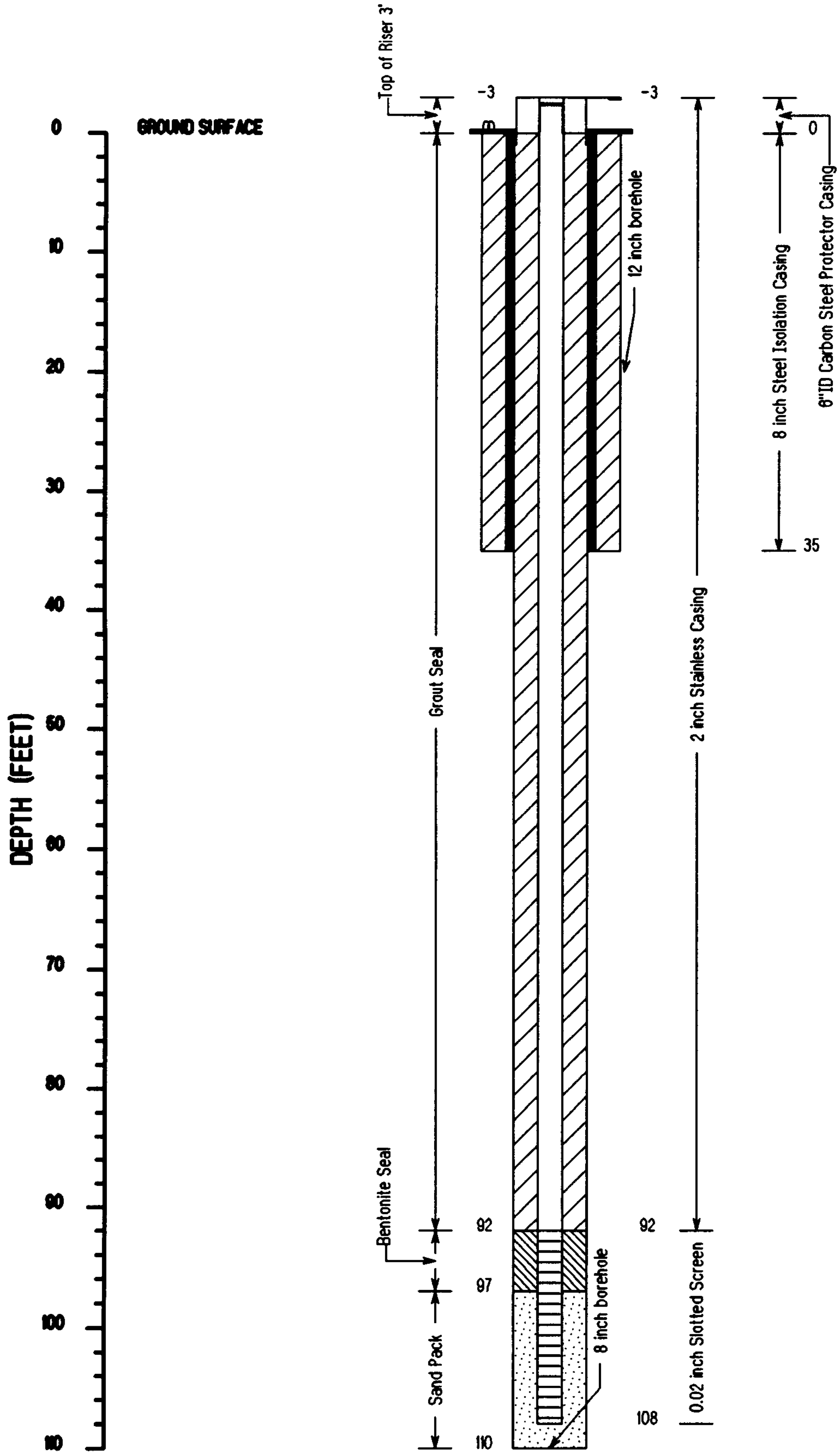
PGDP Phase II Site Investigation
SE Corner of C-400 Building



WELL CONSTRUCTION DETAILS
WELL MW-157
ELEVATION: 2" TOC 381.56 ft. MSL

PGDP Phase II Site Investigation
Paducah, Kentucky

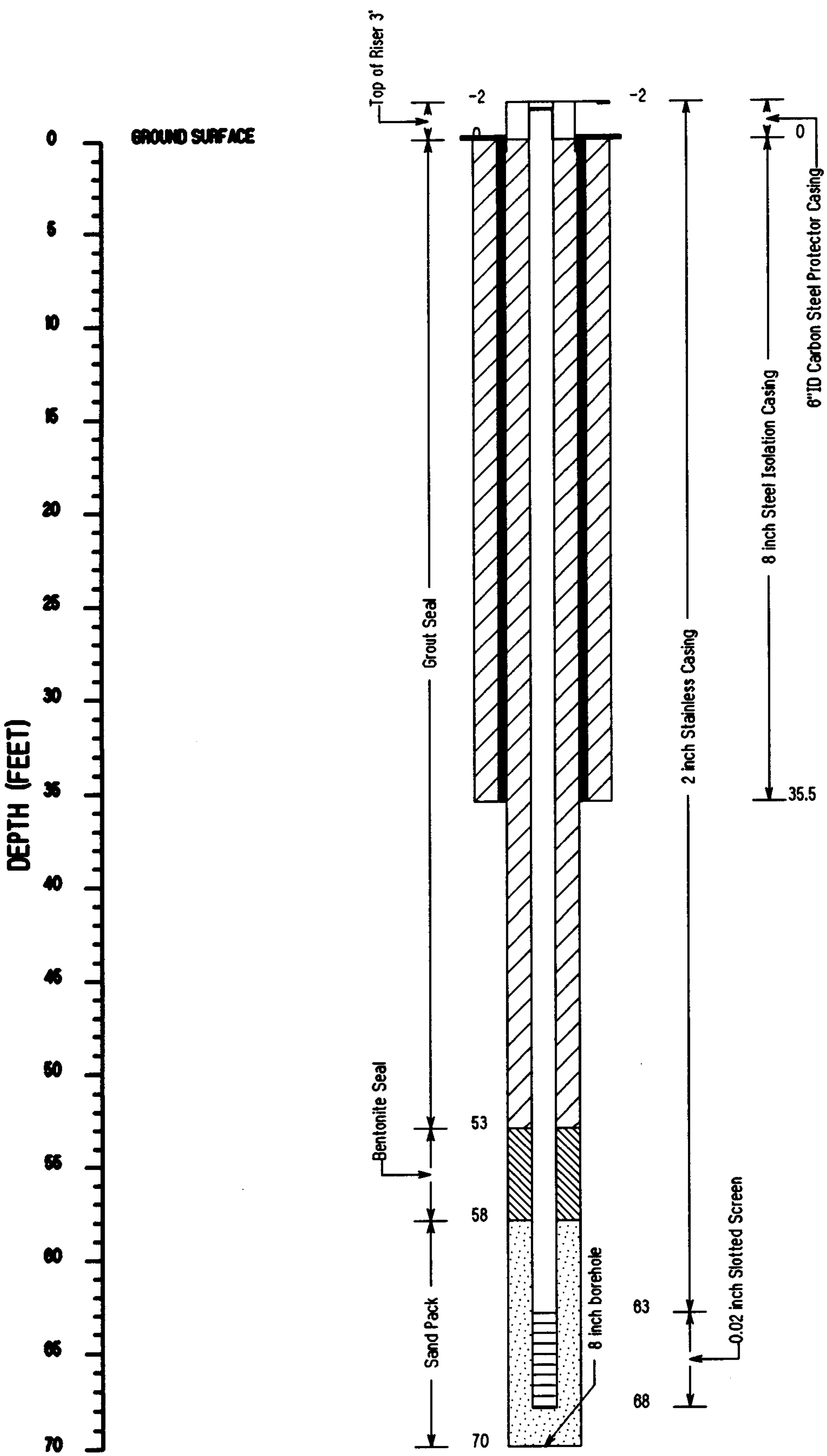
(See Logbook # 15)



WELL CONSTRUCTION DETAILS
WELL MW-158
ELEVATION: 2" TOC N/A

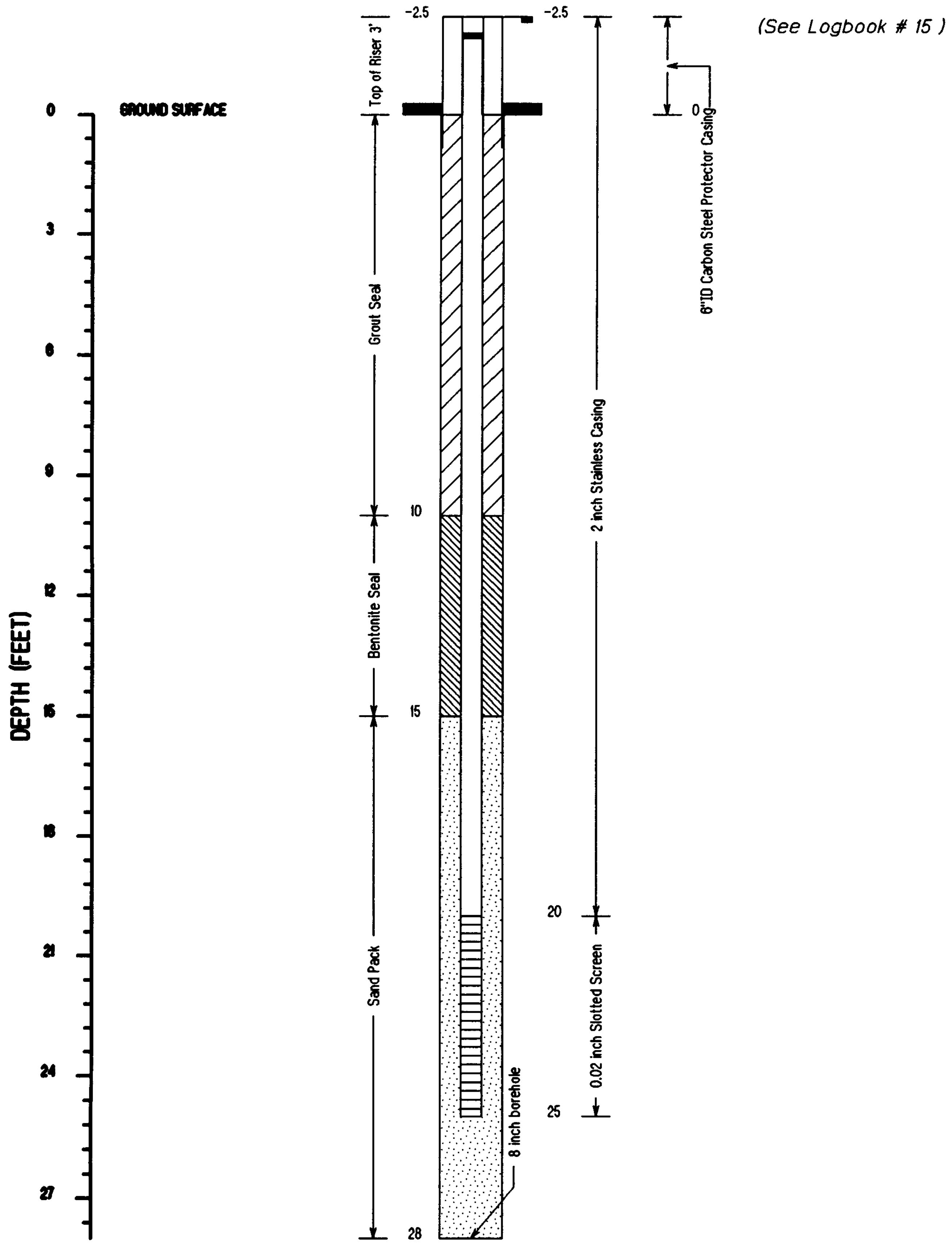
PGDP Phase II Site Investigation
WMU-91, Cylinder Drop Test Area

(See Logbook # 15)



WELL CONSTRUCTION DETAILS
WELL MW-159
ELEVATION: 2" TOC N/A

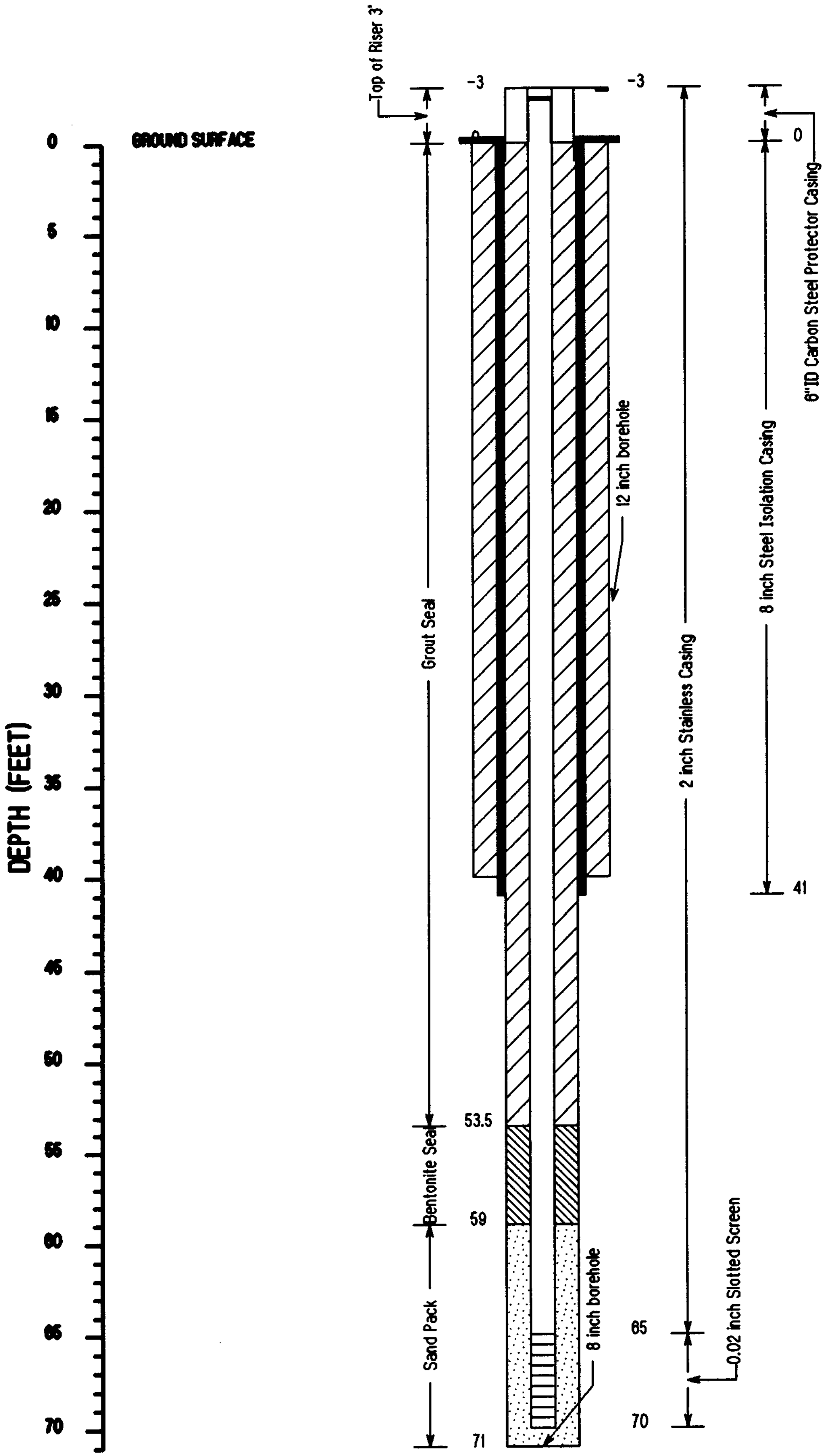
PGDP Phase II Site Investigation
WMU-91, Cylinder Drop Test Area



WELL CONSTRUCTION DETAILS
WELL MW-160
ELEVATION: 2" TOC N/A

PGDP Phase II
Paducah, Kentucky

(See Logbook # 18)

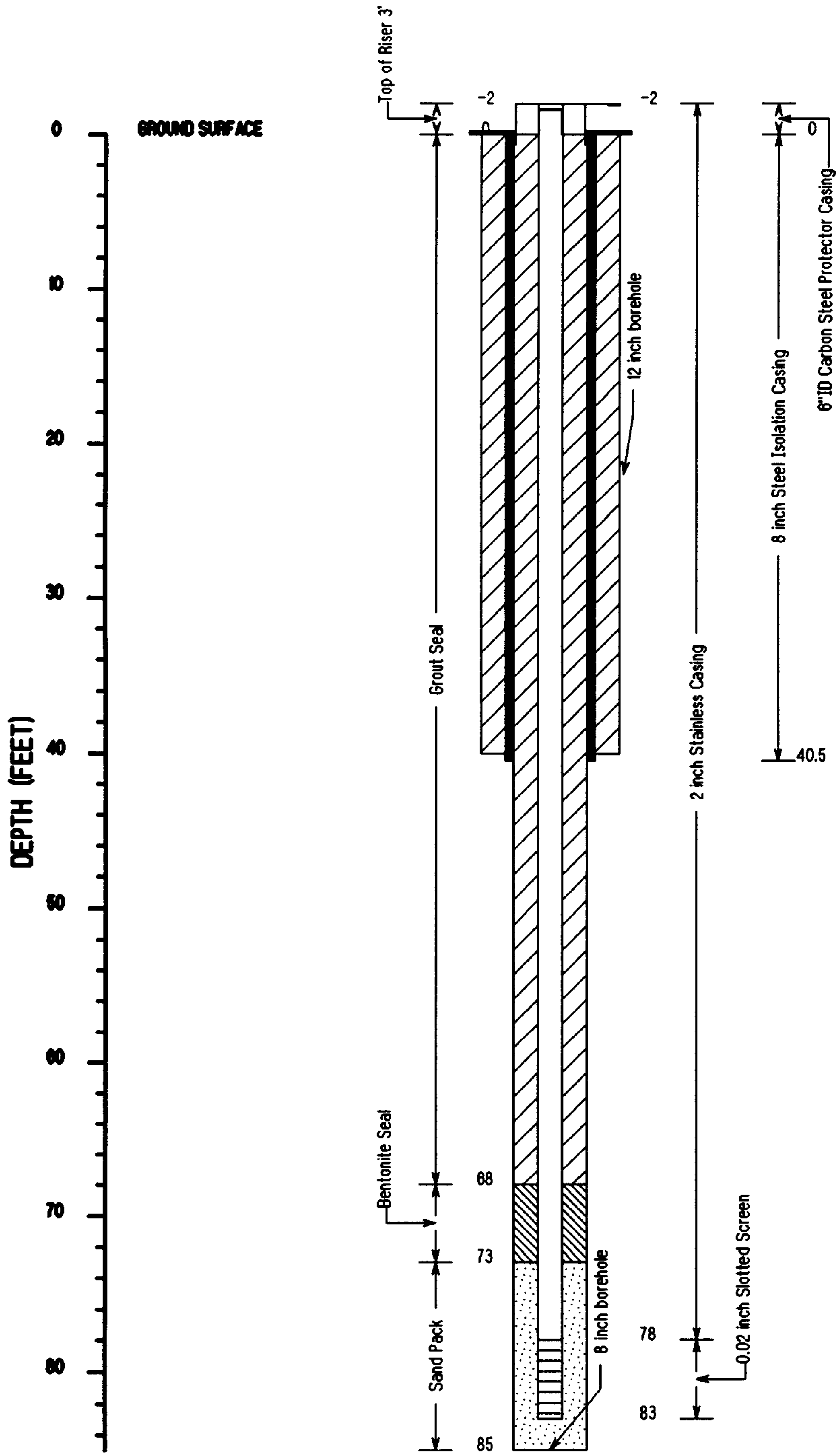


WELL CONSTRUCTION DETAILS
WELL MW-161
ELEVATION: 2" TOC N/A

PGDP Phase II Site Investigation
WMU-1, North of Oil Landfarm

Note: This monitoring well was pressure grouted from total depth to ground surface on 1/29/91

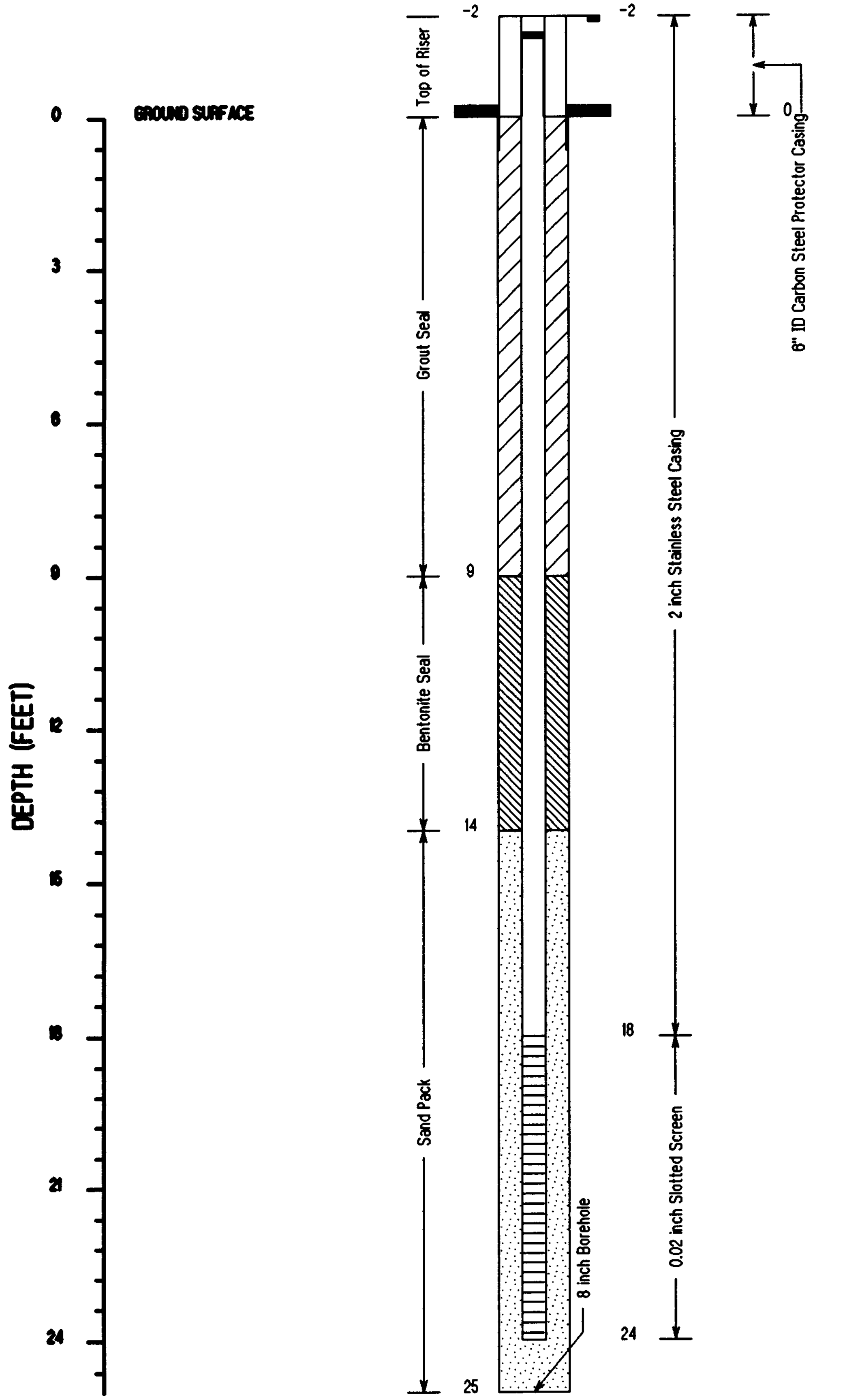
(See Logbook # 34)



WELL CONSTRUCTION DETAILS
WELL MW-161
ELEVATION: 2" TOC 373.55 ft. MSL

PGDP Phase II Site Investigation
WMU-1, North of Oil Landfarm

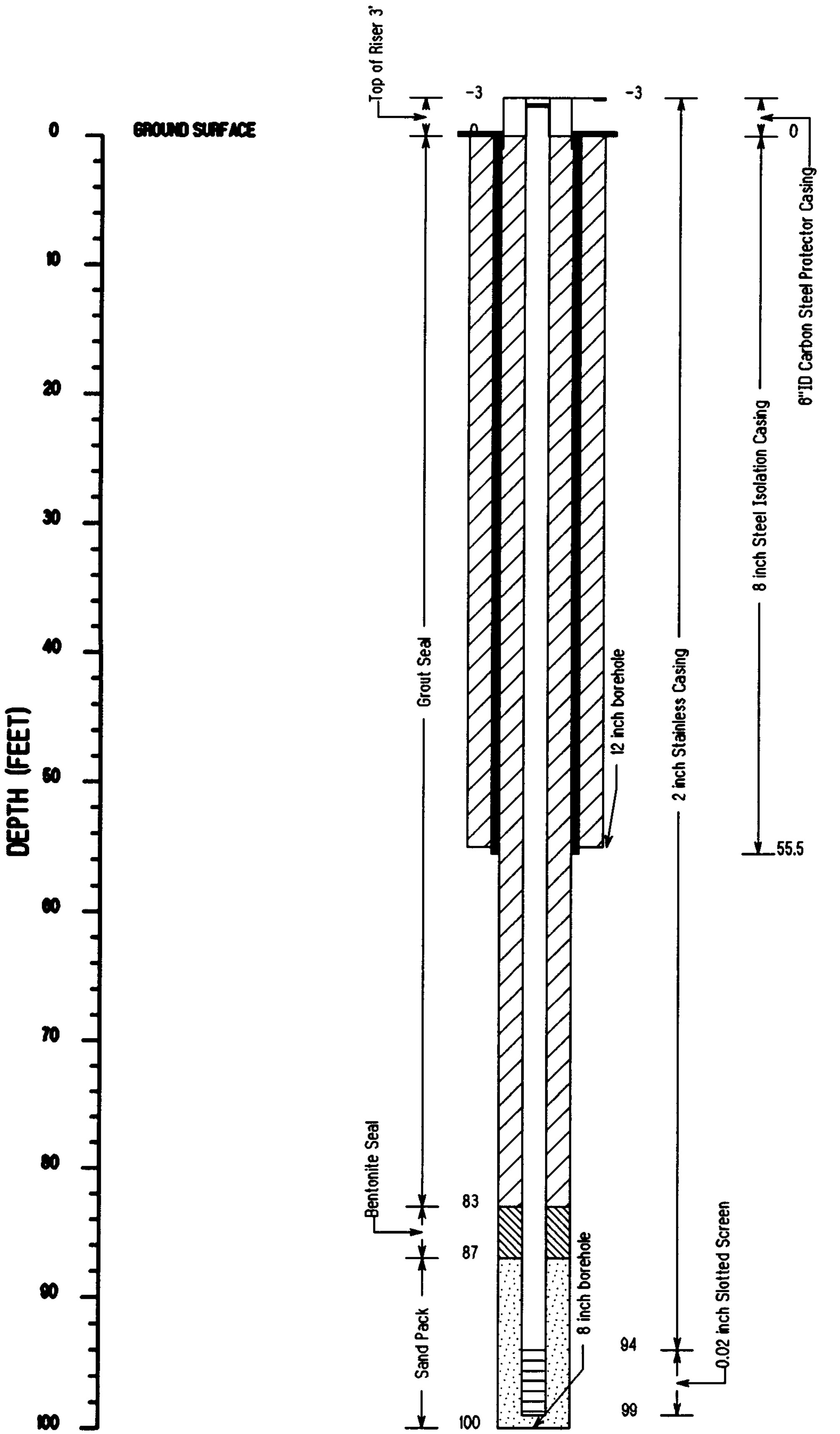
(See Logbook # 18)



WELL CONSTRUCTION DETAILS
WELL MW-162
ELEVATION: 2" TOC 374.17 ft. MSL

PGDP Phase II Site Investigation
WMU-1, North of Oil Landfarm

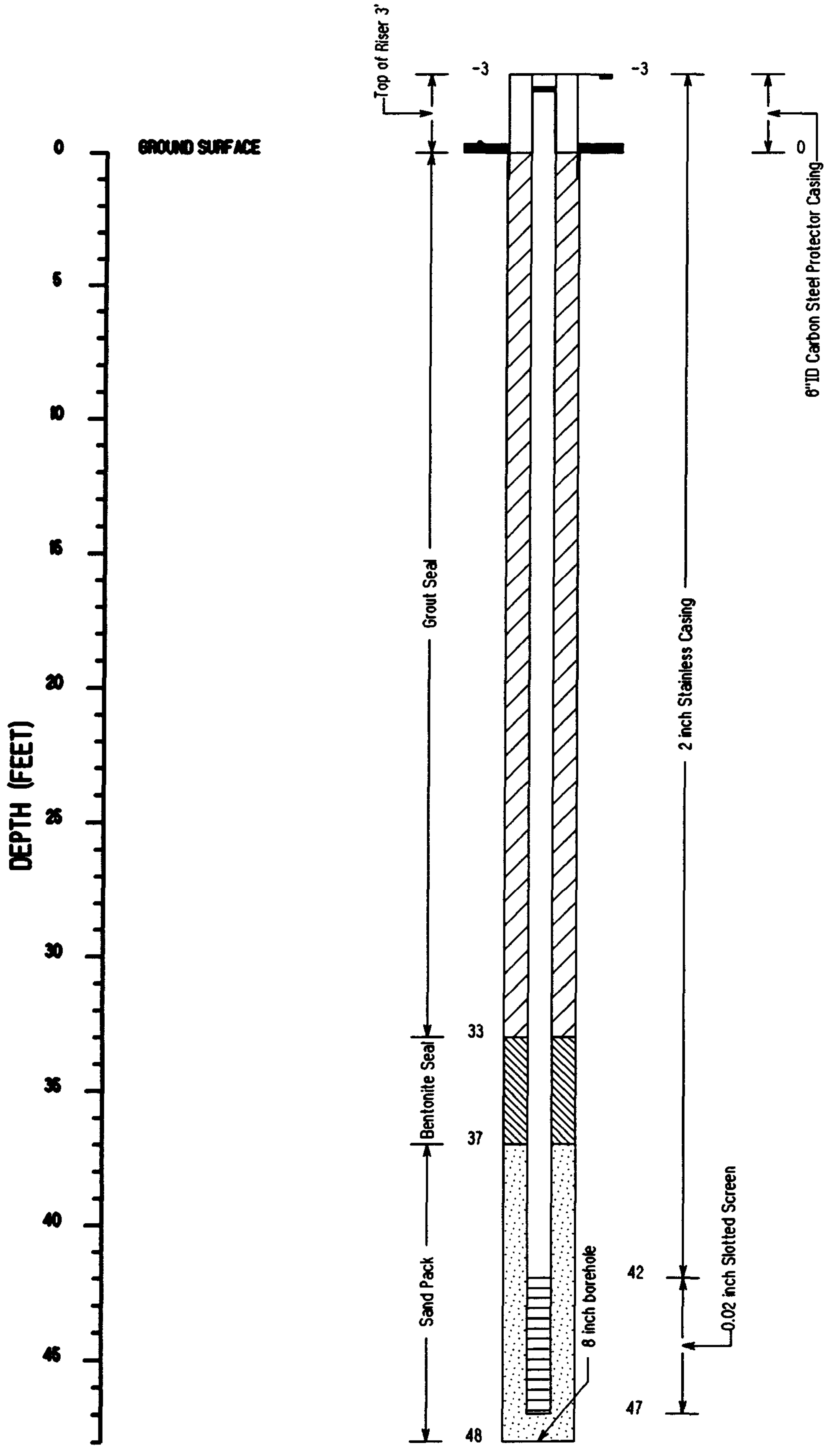
(See Logbook # 18)



WELL CONSTRUCTION DETAILS
WELL MW-163
ELEVATION: 2" TOC 386.14 ft. MSL

PGDP Phase II Site Investigation
East Plant Area, near Bldg. C-746-G

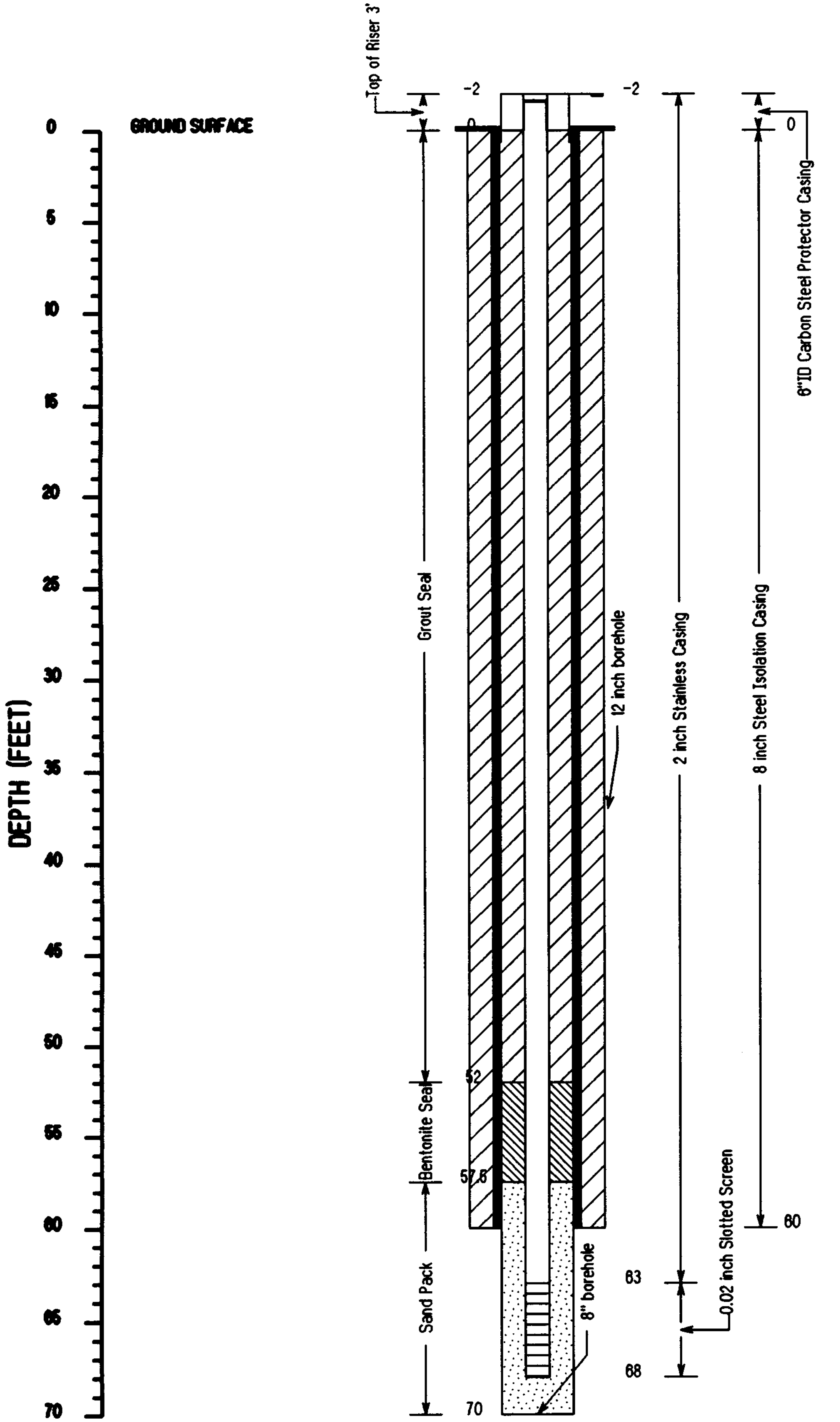
(See Logbook # 18)



WELL CONSTRUCTION DETAILS
WELL MW-164
ELEVATION: 2" TOC 386.29 ft. MSL

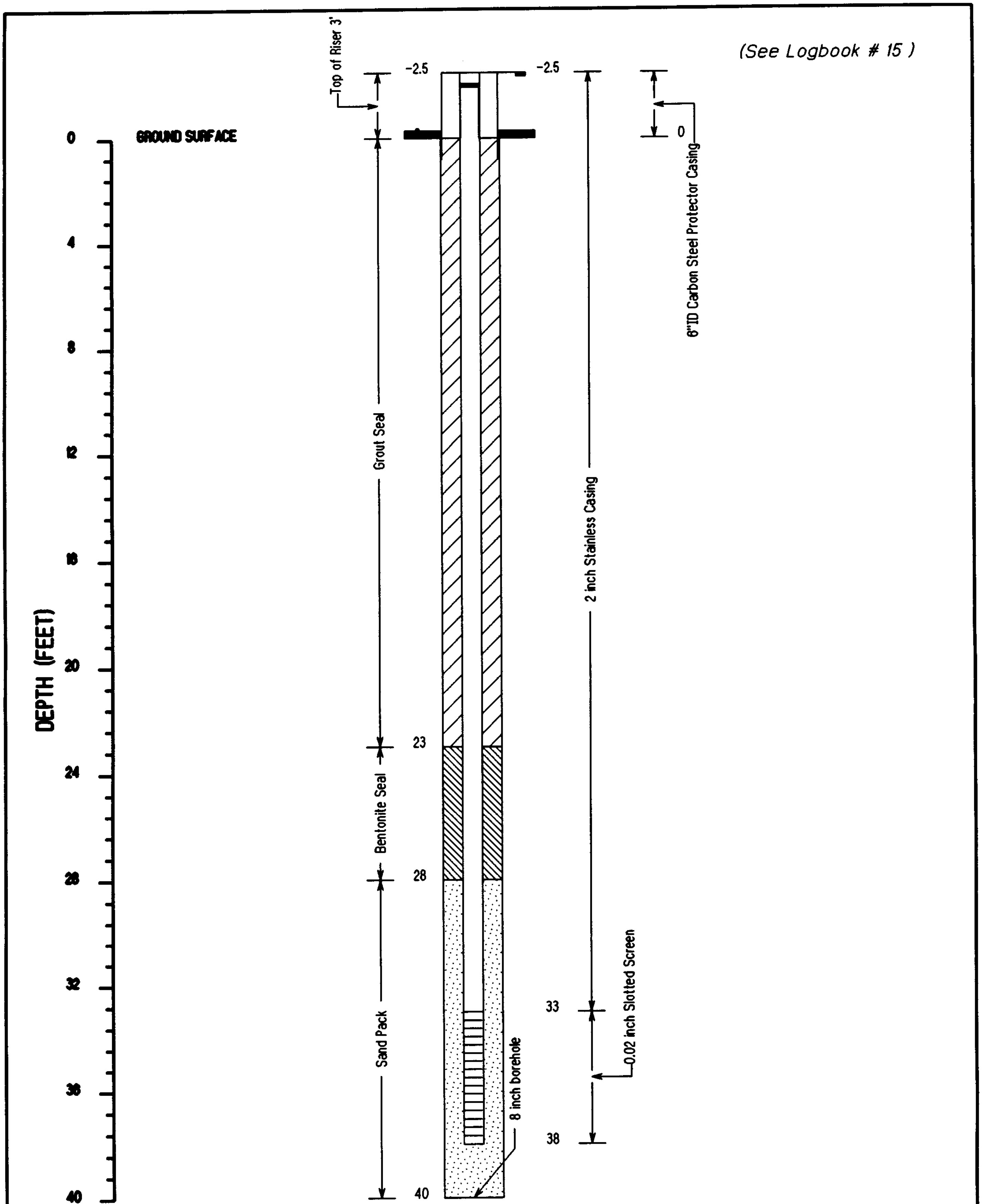
PGDP Phase II
Paducah, Kentucky

(See Logbook # 15)



WELL CONSTRUCTION DETAILS
WELL MW-165
ELEVATION: 2" TOC 379.74 ft. MSL

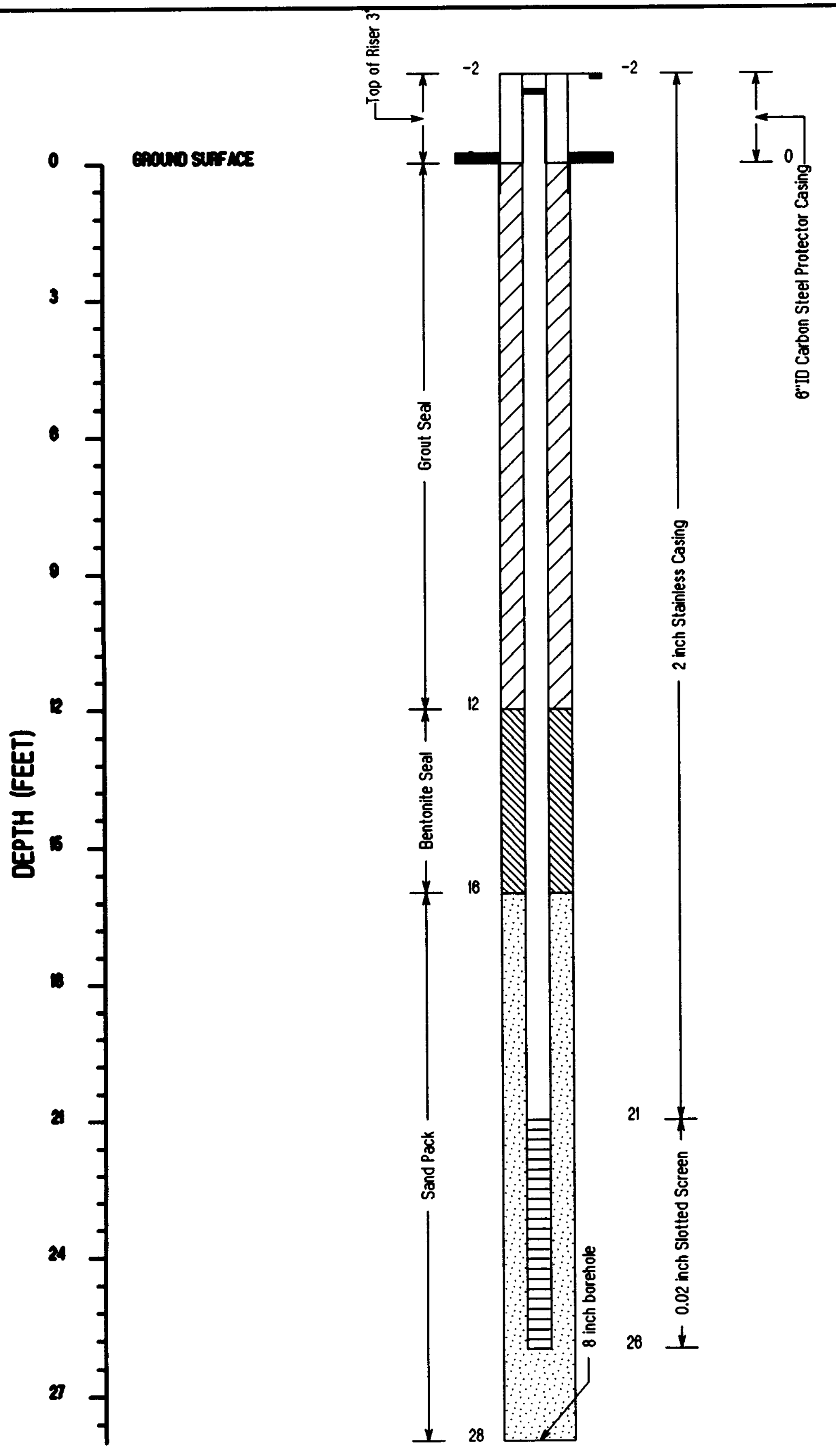
PGDP Phase II Site Investigation
North Plant Area, corner of Wyoming & 15th St.



WELL CONSTRUCTION DETAILS
WELL MW-166
ELEVATION: 2" TOC 380.07 ft. MSL

PGDP Phase II
Paducah, Kentucky

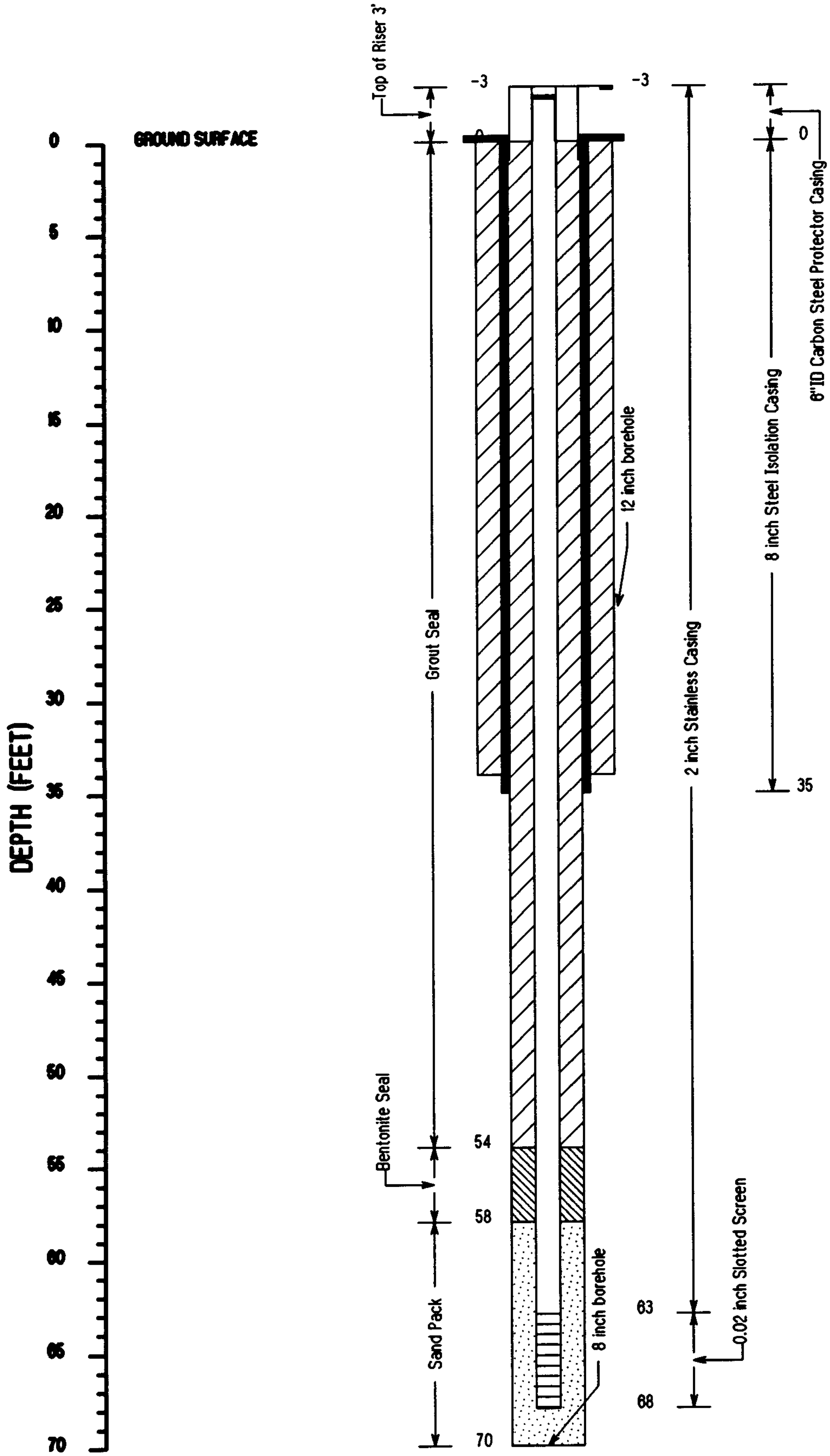
(See Logbook # 18 and 27)



WELL CONSTRUCTION DETAILS
WELL MW-167
ELEVATION: 2" TOC 376.36 ft. MSL

PGDP Phase II
Paducah, Kentucky

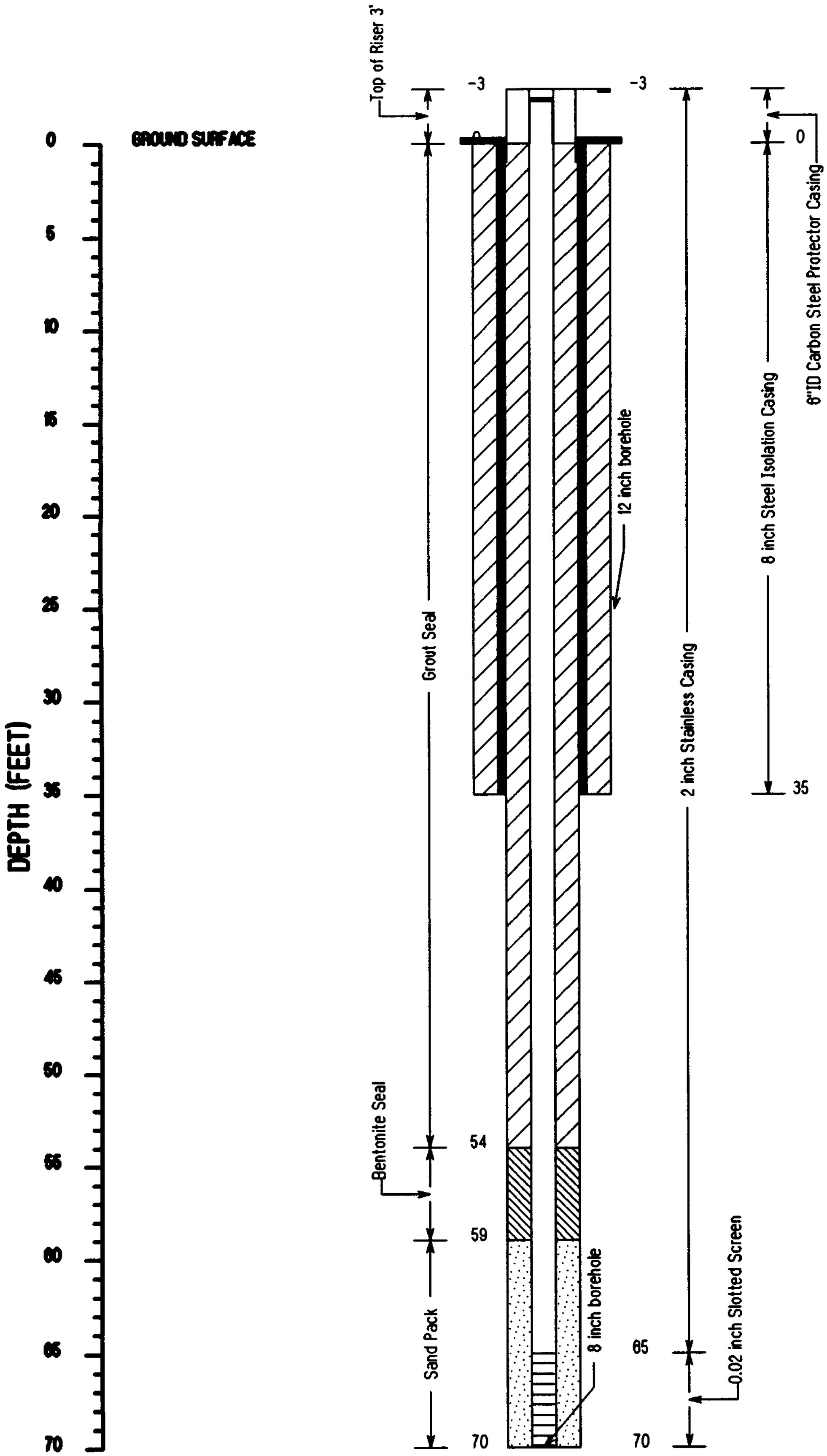
(See Logbook # 27)



WELL CONSTRUCTION DETAILS
WELL MW-168
ELEVATION: 2" TOC 377.42 ft. MSL

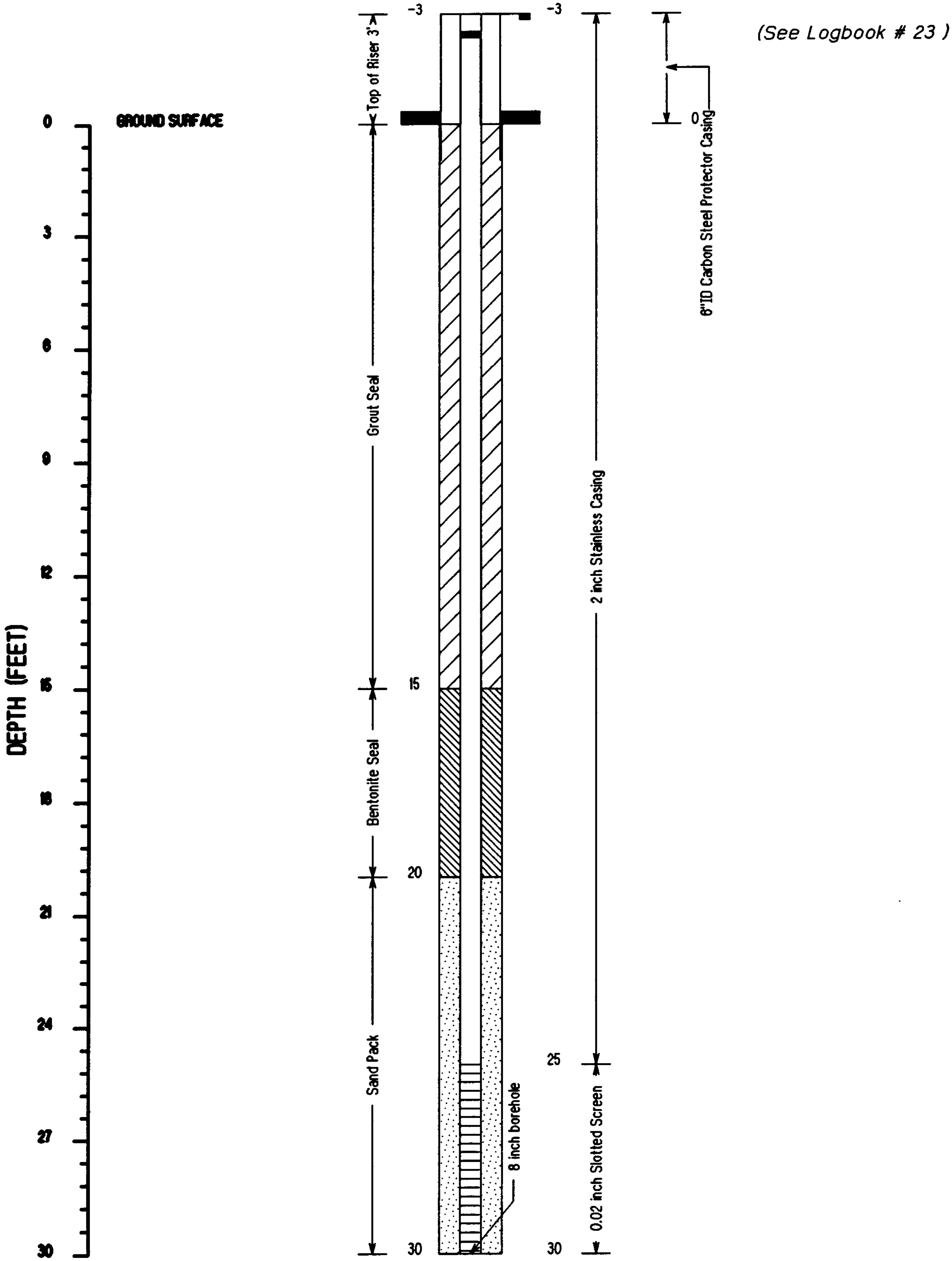
PGDP Phase II Site Investigation
Diesel Spill Area, near Virgina and 10th St.

(See Logbook # 23)



WELL CONSTRUCTION DETAILS
WELL MW-169
ELEVATION: 2" TOC 373.41 ft. MSL

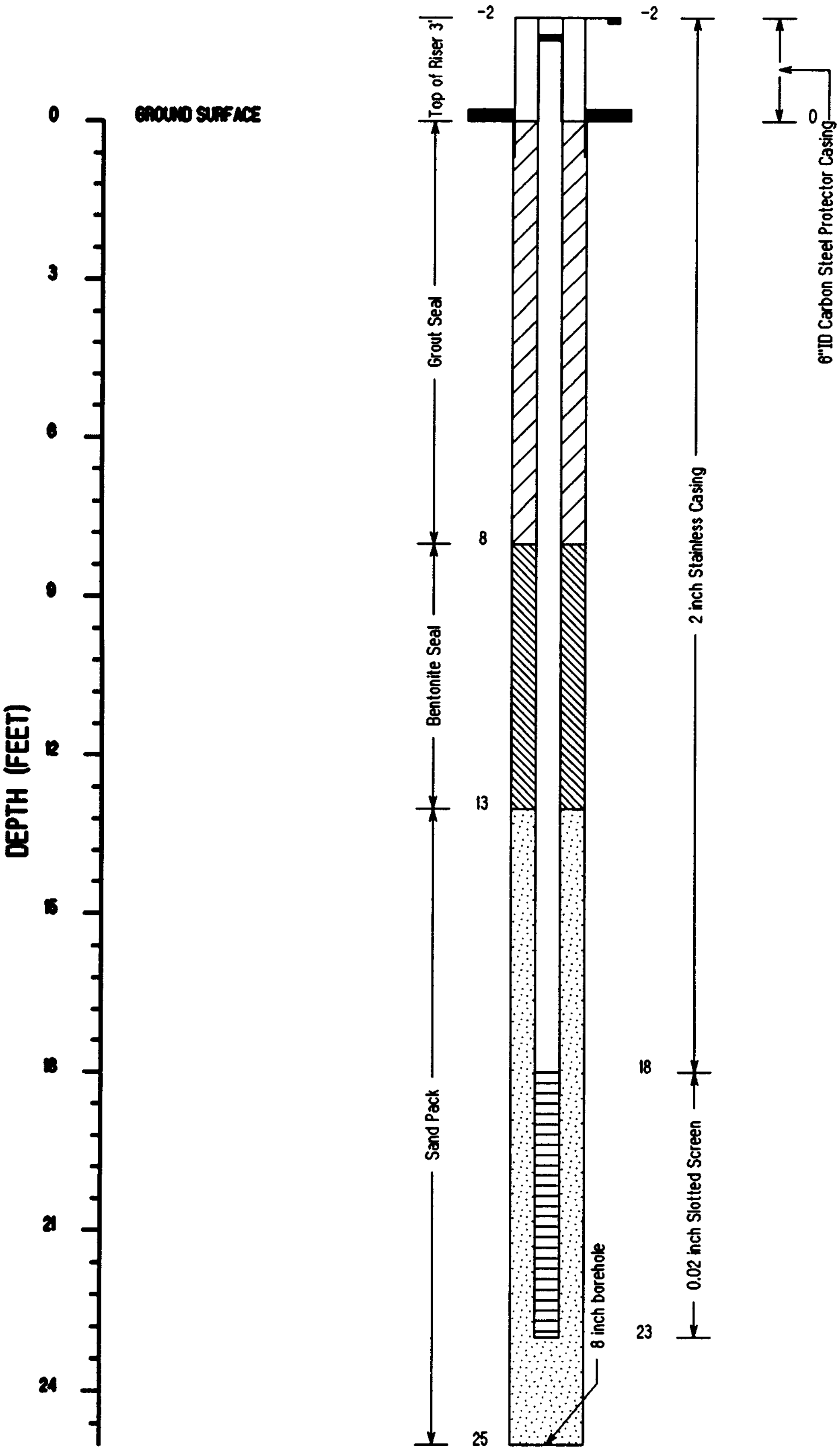
PGDP Phase II Site Investigation
001-Ditch, N. of C-745-C Yard



WELL CONSTRUCTION DETAILS
WELL MW-170
ELEVATION: 2" TOC 373.98 ft. MSL

PGDP Phase II Site Investigation
Puducah, Kentucky

(See Logbook # 24)



WELL CONSTRUCTION DETAILS

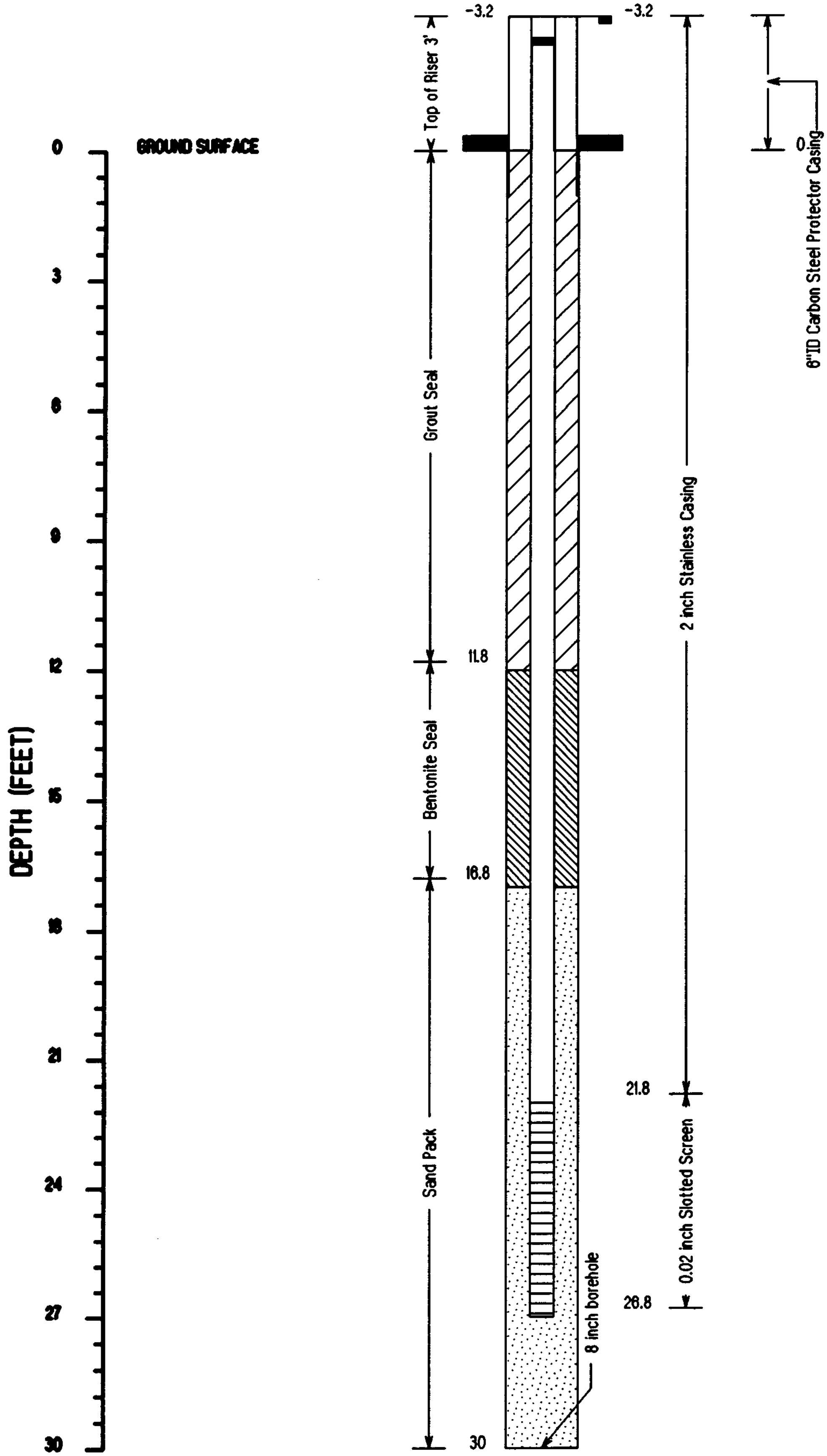
WELL MW-171

ELEVATION: 2" TOC 374.63 ft. MSL

PGDP Phase II Site Investigation

001-Ditch, 100' E. of C-745-C Yard

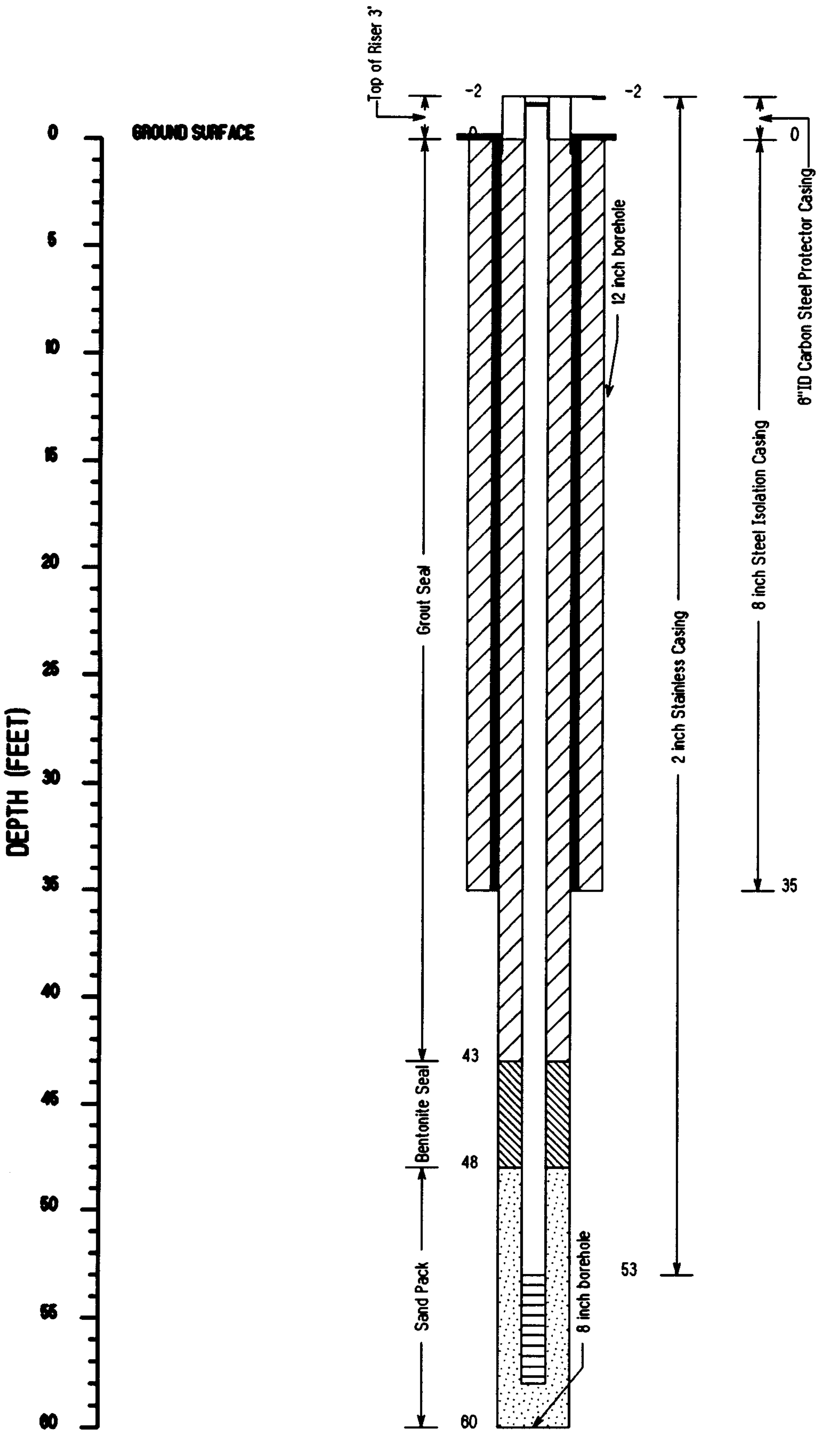
(See Logbook # 24)



WELL CONSTRUCTION DETAILS
WELL MW-172
ELEVATION: 2" TOC 373.79 ft. MSL

PGDP Phase II Site Investigation
0001-Ditch, North of C-745-C Yard

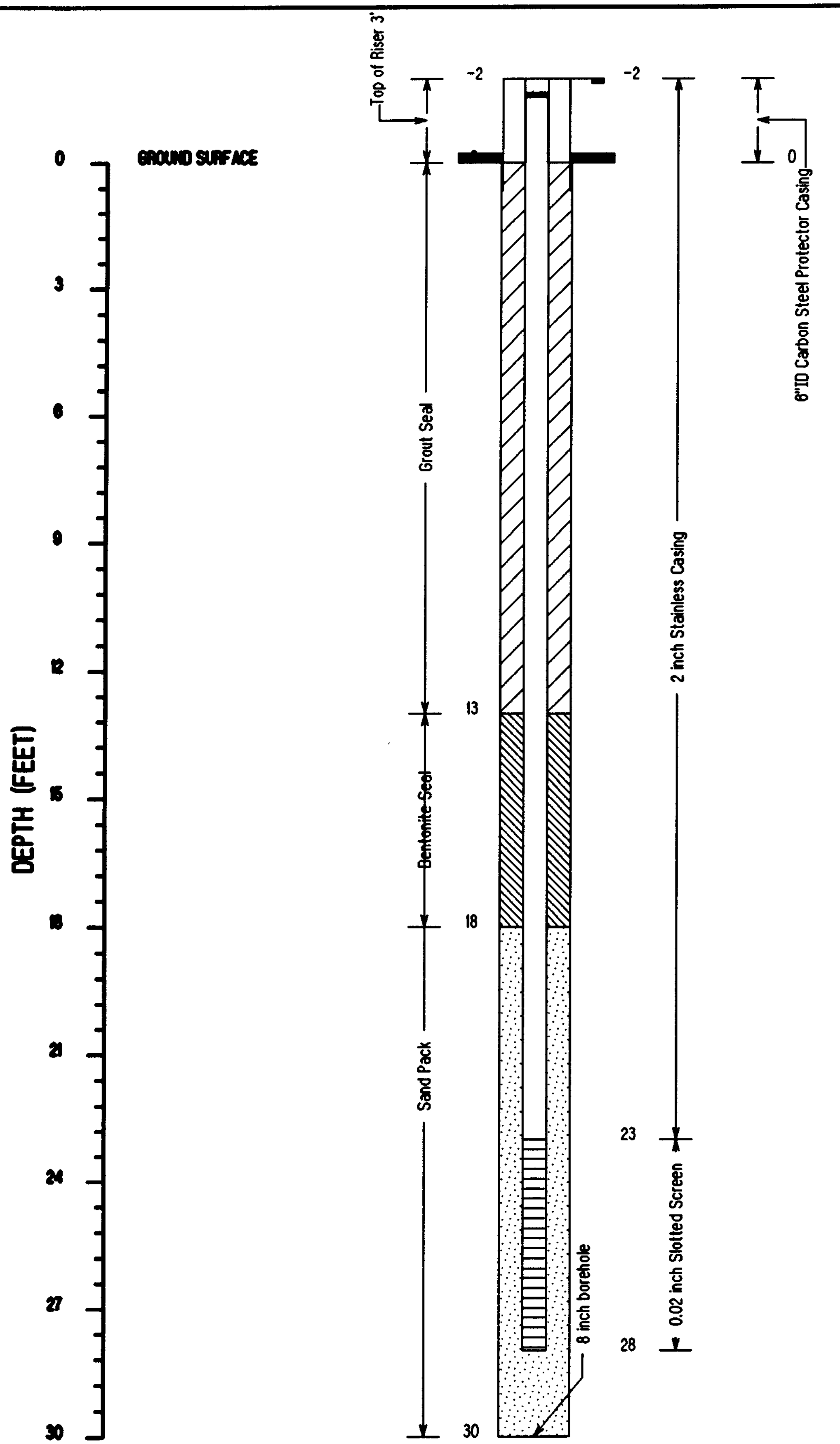
(See Logbook # 24)



WELL CONSTRUCTION DETAILS
WELL MW-173
ELEVATION: 2" TOC 373.30 ft. MSL

PGDP Phase II Site Investigation
Upgradient of Lagoons, N. of C-746-C Yard

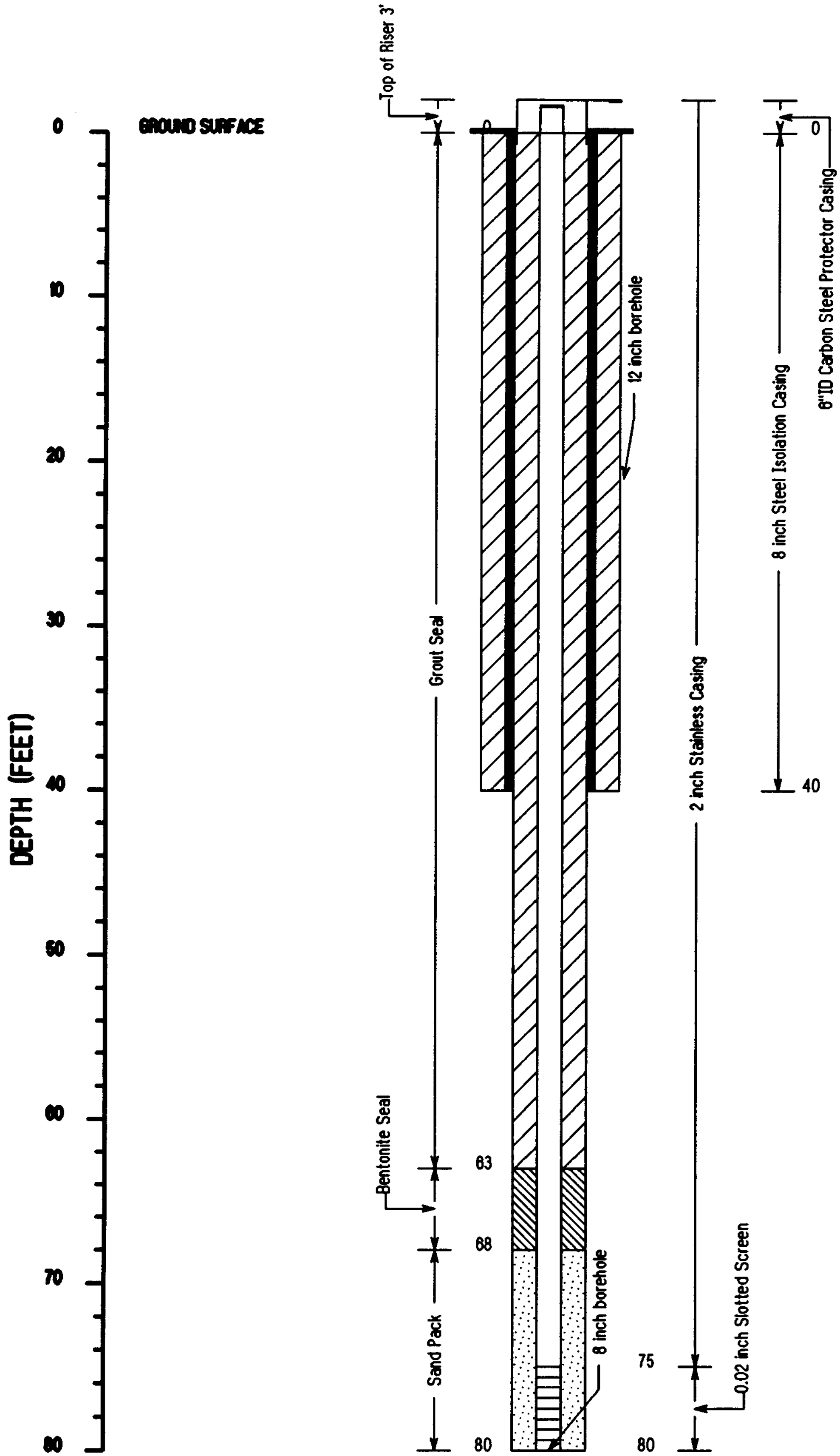
(See Logbook # 24)



WELL CONSTRUCTION DETAILS
WELL MW-174
ELEVATION: 2" TOC 373.29 ft. MSL

PGDP Phase II
Paducah, Kentucky

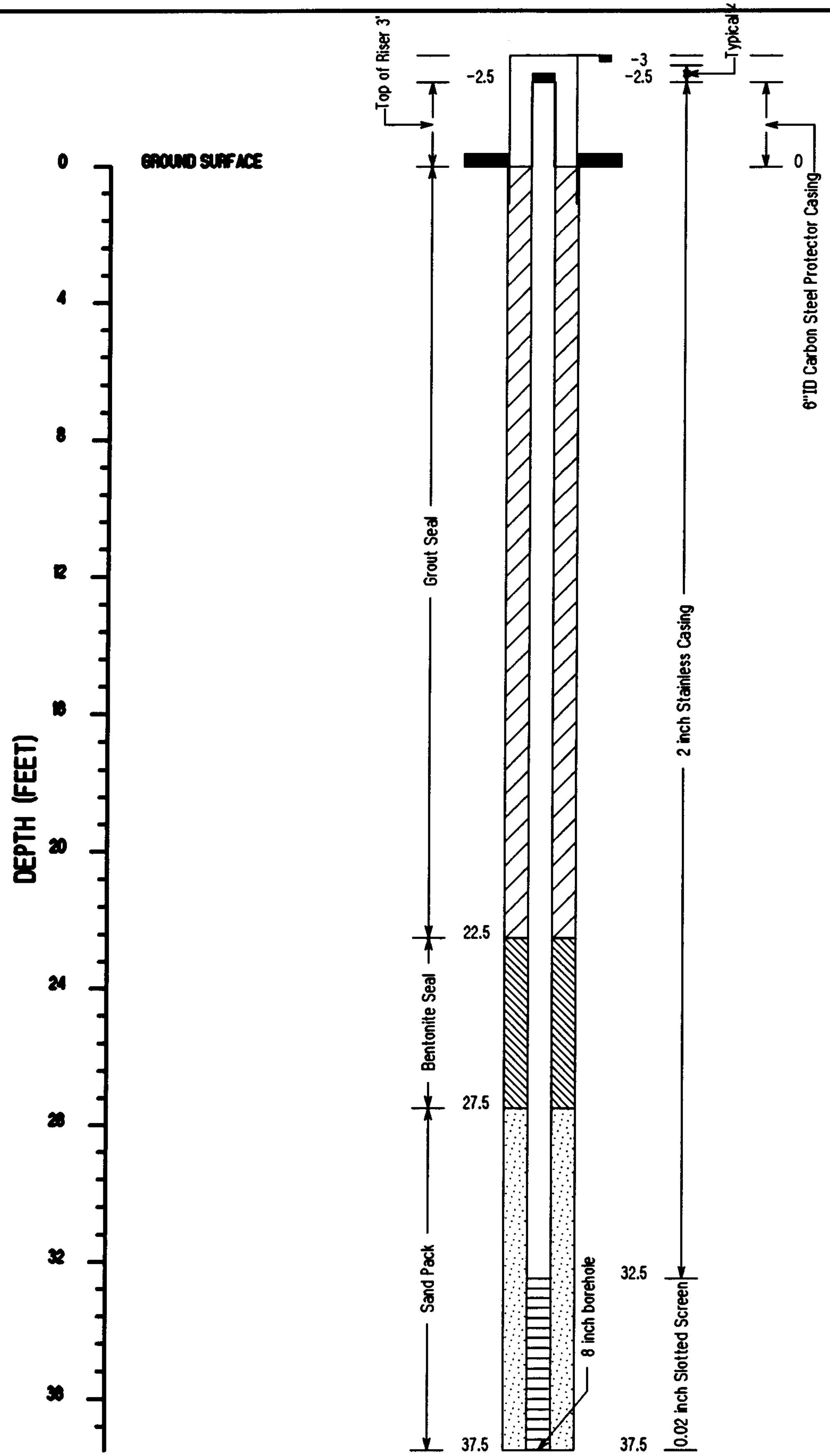
(See Logbook # 25)



WELL CONSTRUCTION DETAILS
WELL MW-175
ELEVATION: 2" TOC 381.18 ft. MSL

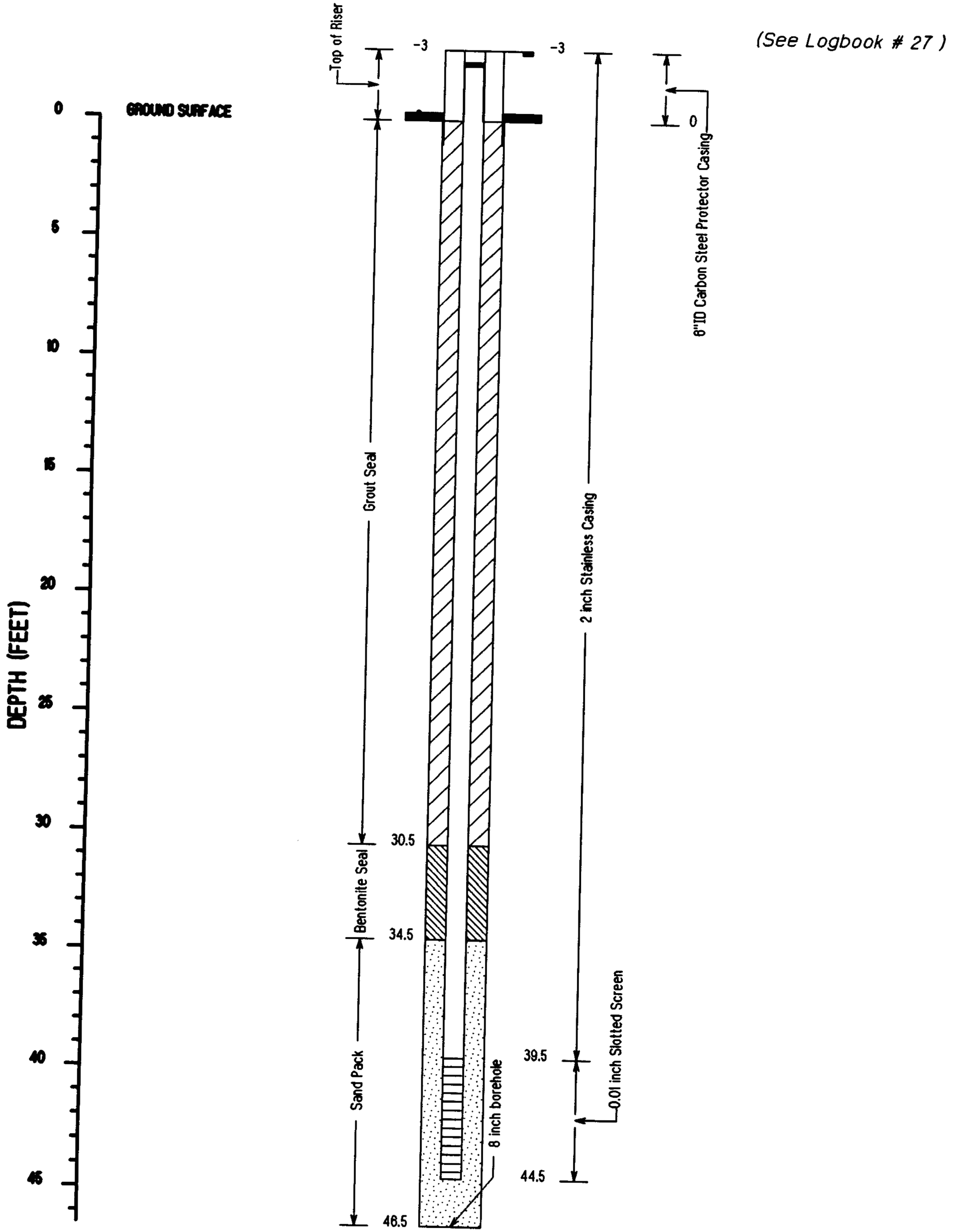
PGDP Phase II Site Investigation
WMU-47, West side of C-400 Bldg.

(See Logbook # 25)



WELL CONSTRUCTION DETAILS
WELL MW-176
ELEVATION: 2" TOC 381.23 ft. MSL

PGDP Phase II
Paducah, Kentucky



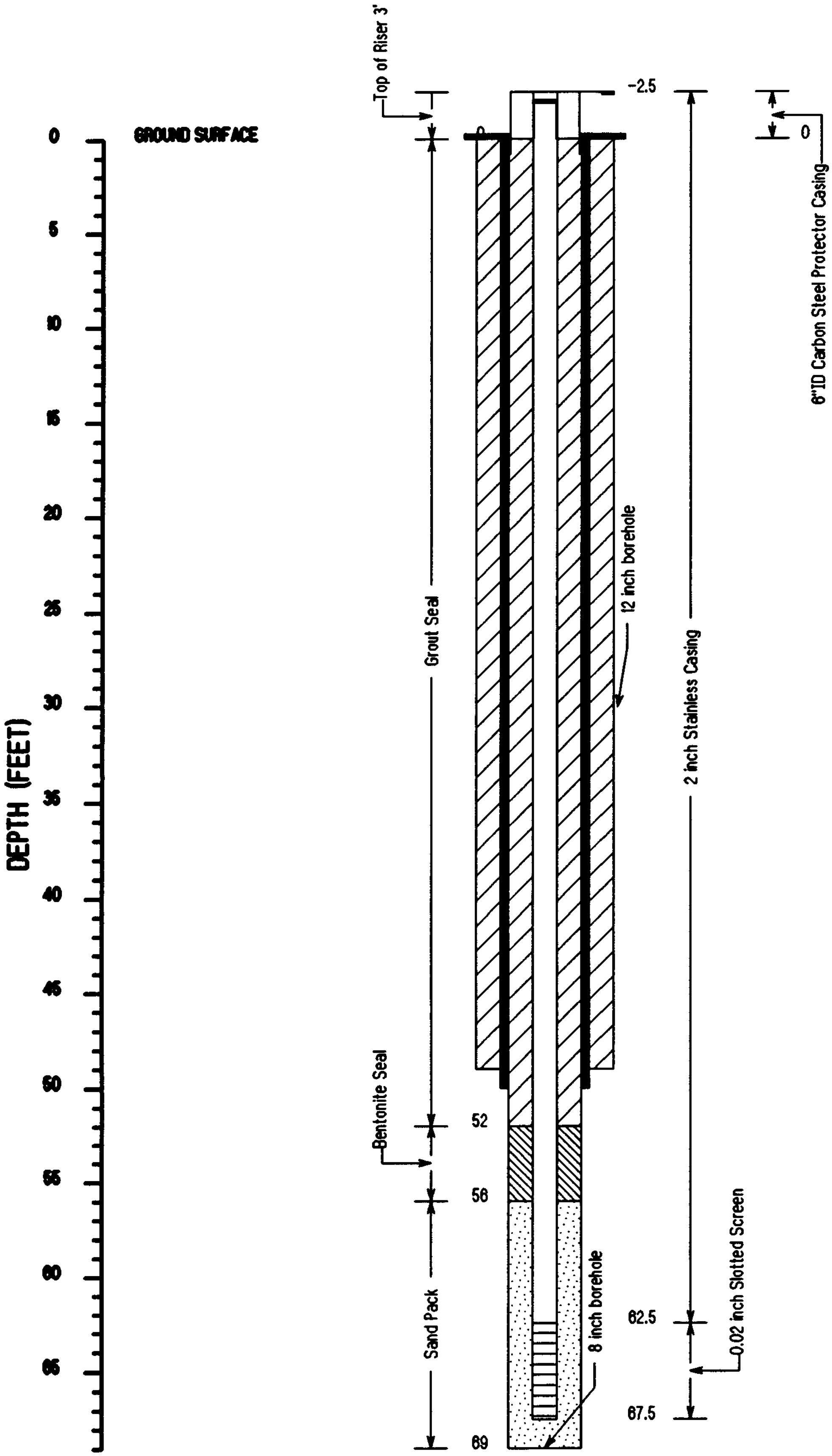
WELL CONSTRUCTION DETAILS

WELL MW-177

ELEVATION: 2" TOC 379.74 ft. MSL

PGDP Phase II Site Investigation

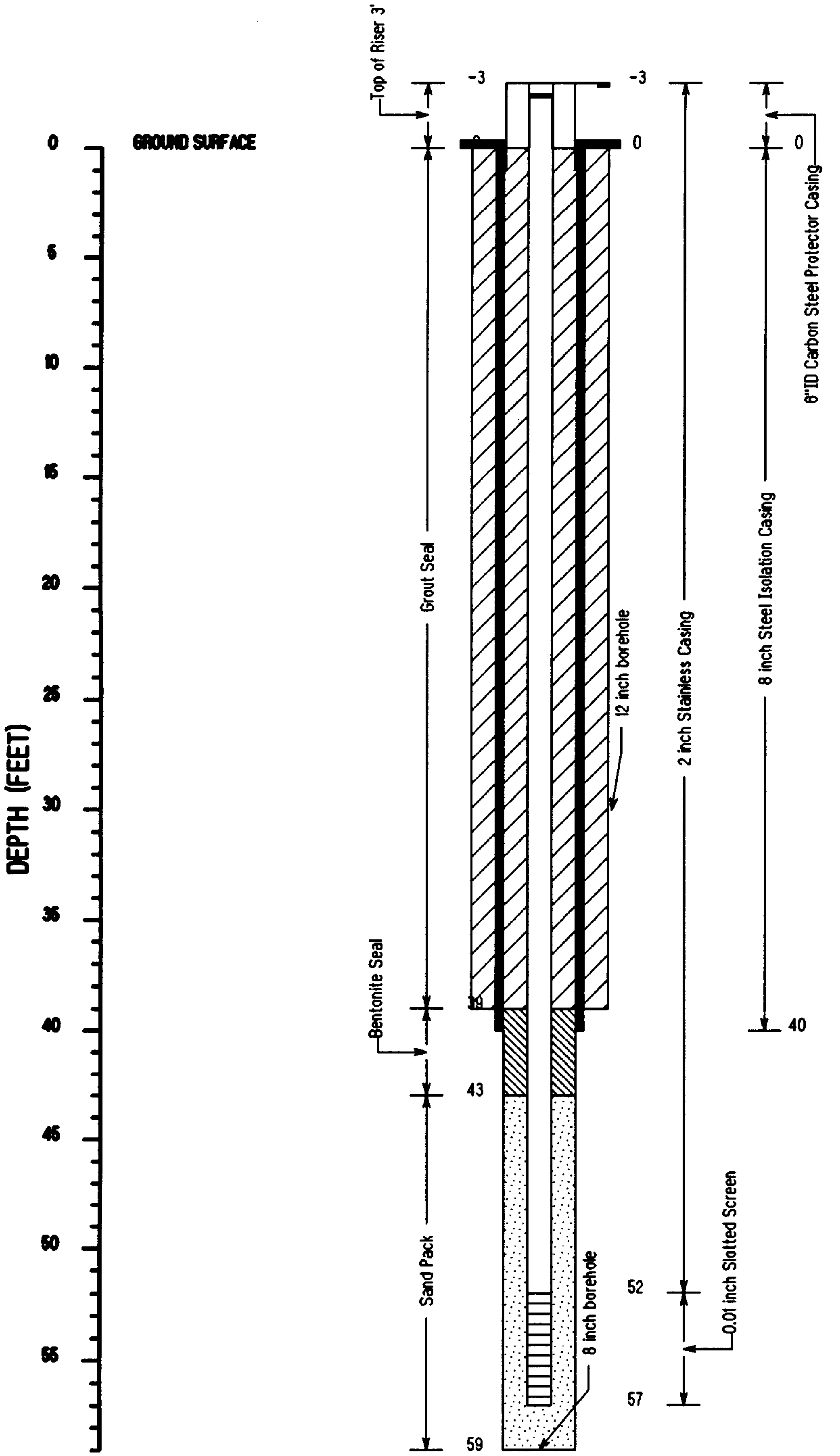
(See Logbook # 27)



WELL CONSTRUCTION DETAILS
WELL MW-178
ELEVATION: 2" TOC 378.80 ft. MSL

PGDP Phase II Site Investigation
WMU-40, C-400 NE Corner

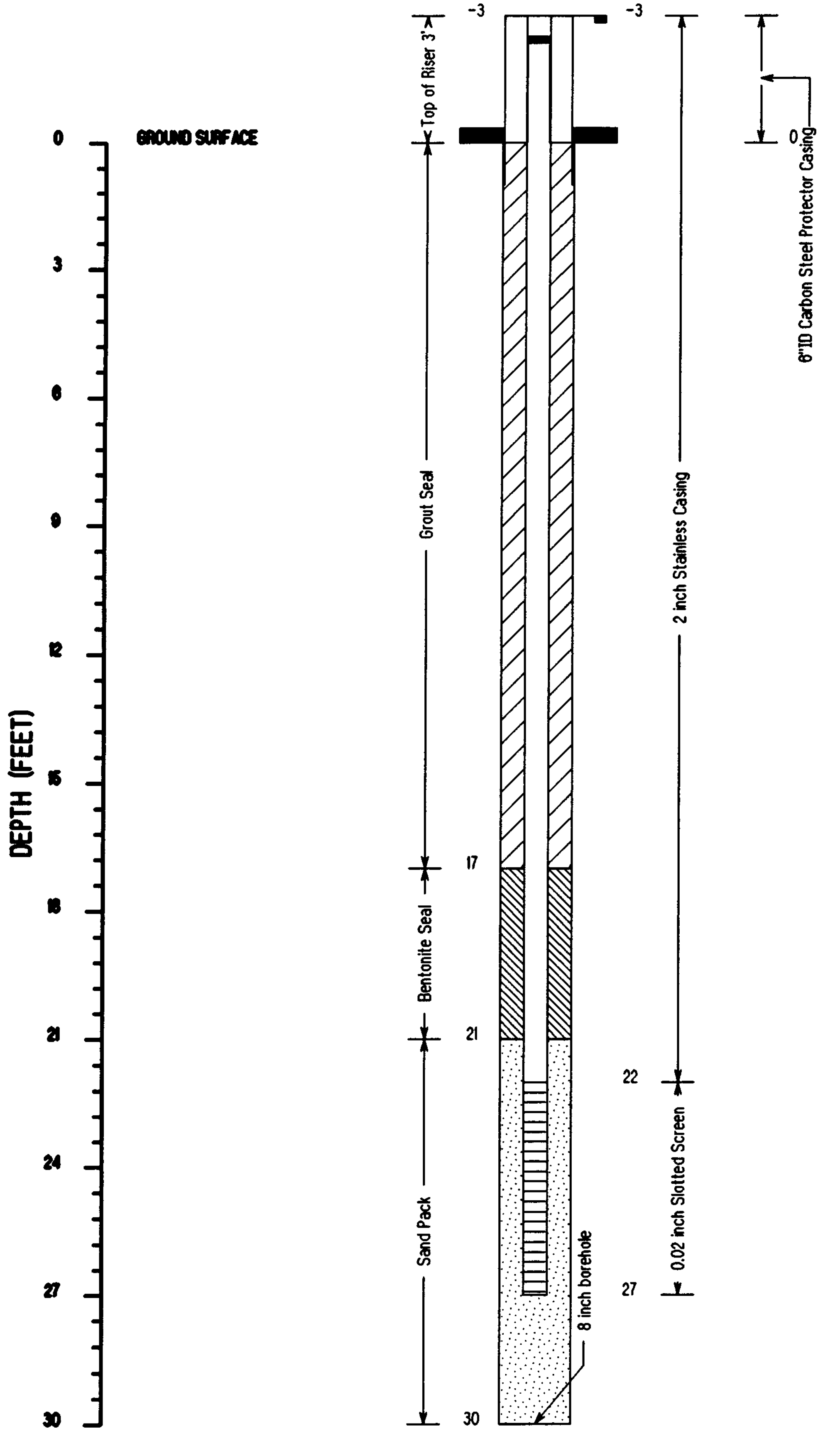
(See Logbook # 35)



WELL CONSTRUCTION DETAILS
WELL MW-179
ELEVATION: 2" TOC 358.60 ft. MSL

PGDP Phase II Site Investigation
North Landfill- N. Side

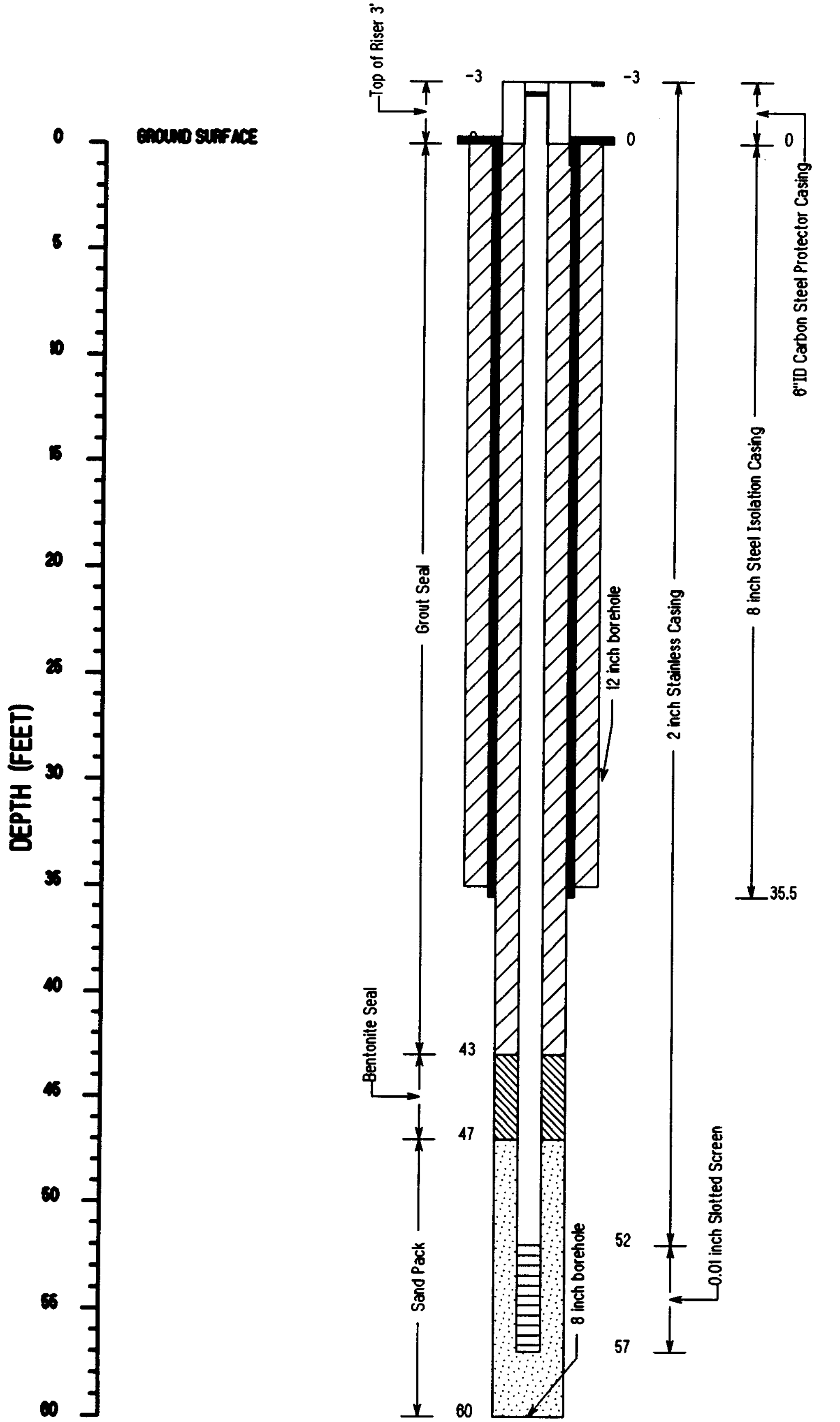
(See Logbook # 35)



WELL CONSTRUCTION DETAILS
WELL MW-180
ELEVATION: 2" TOC 358.11 ft. MSL

PGDP Phase II Site Investigation
North Landfill-N. Side

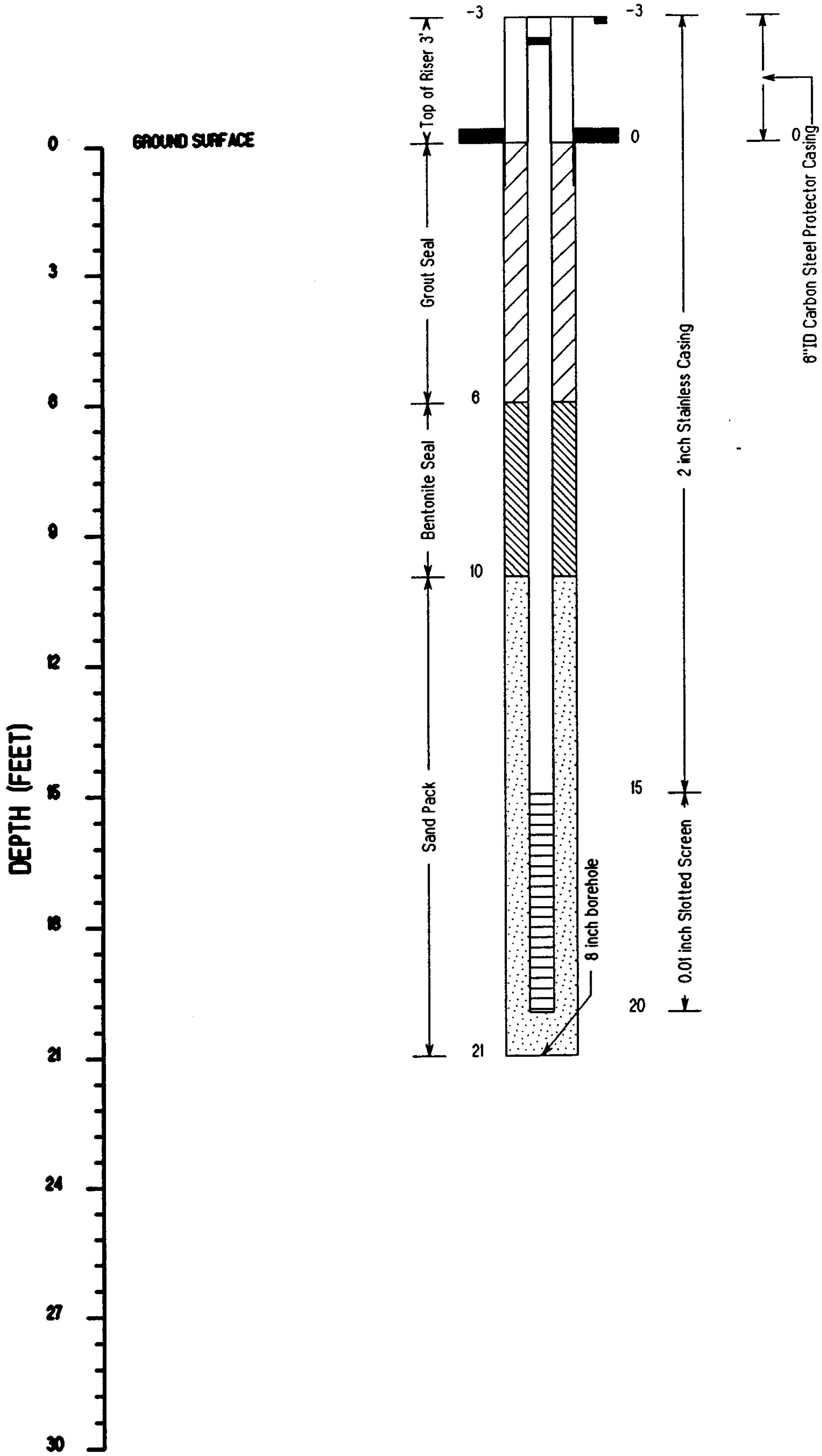
(See Logbook # 42)



WELL CONSTRUCTION DETAILS
WELL MW-181
ELEVATION: 2" TOC 371.15 ft. MSL

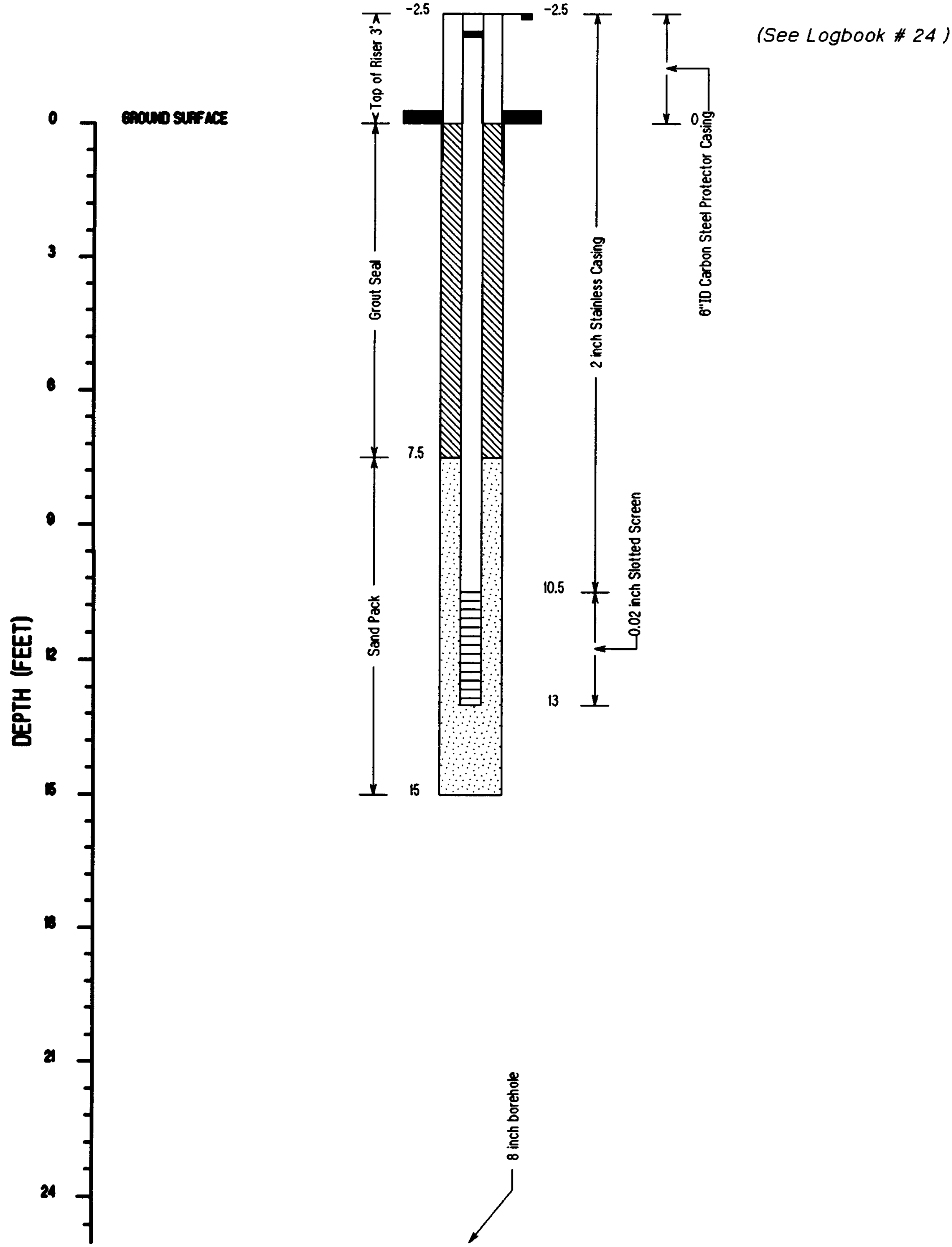
PGDP Phase II Site Investigation
North Landfill, South side

(See Logbook # 42)



WELL CONSTRUCTION DETAILS
WELL MW-182
ELEVATION:

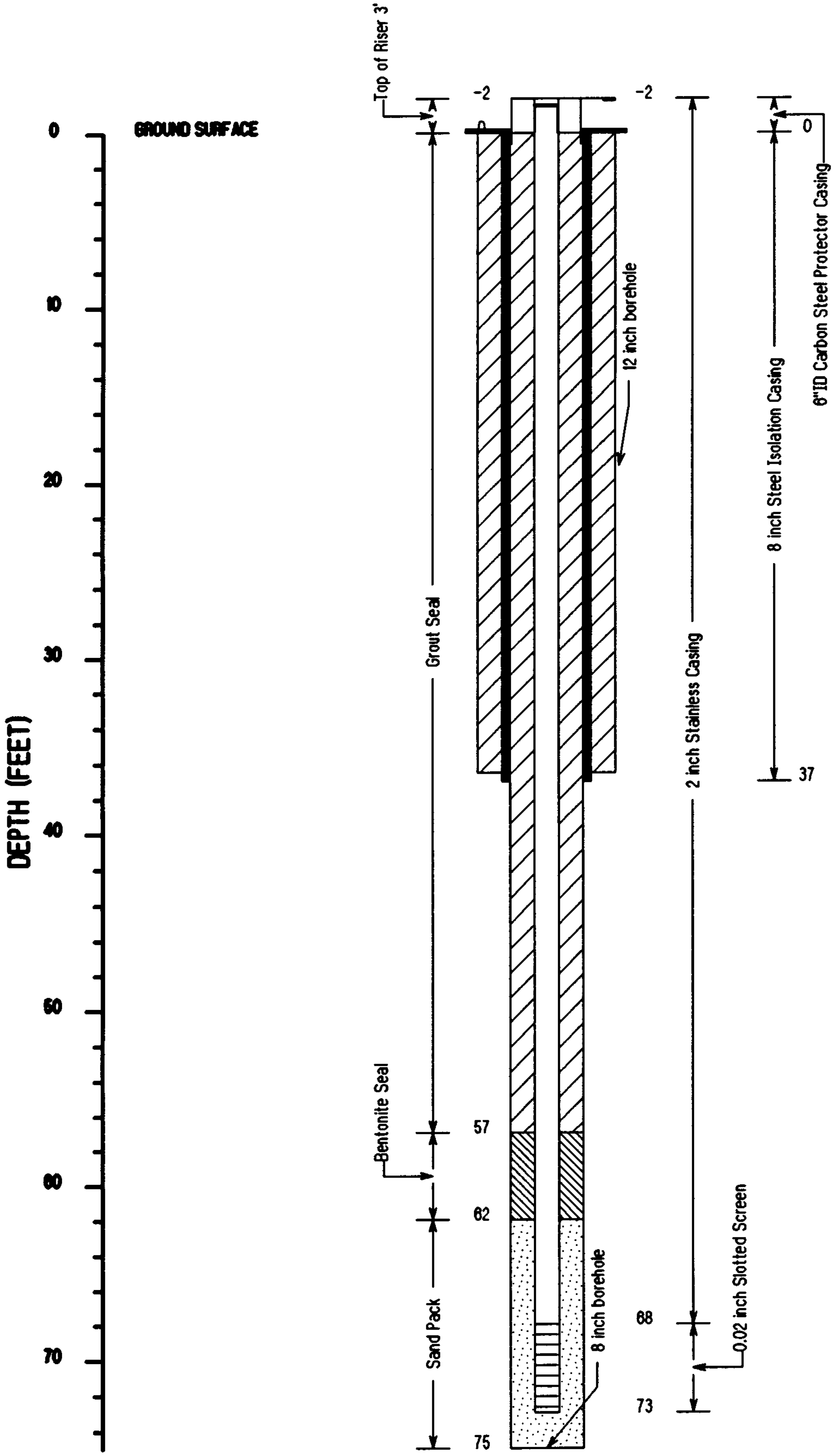
PGDP Phase II Site Investigation



WELL CONSTRUCTION DETAILS
WELL MW-184
ELEVATION: 2" TOC N/A

PGDP Phase II
Paducah, Kentucky

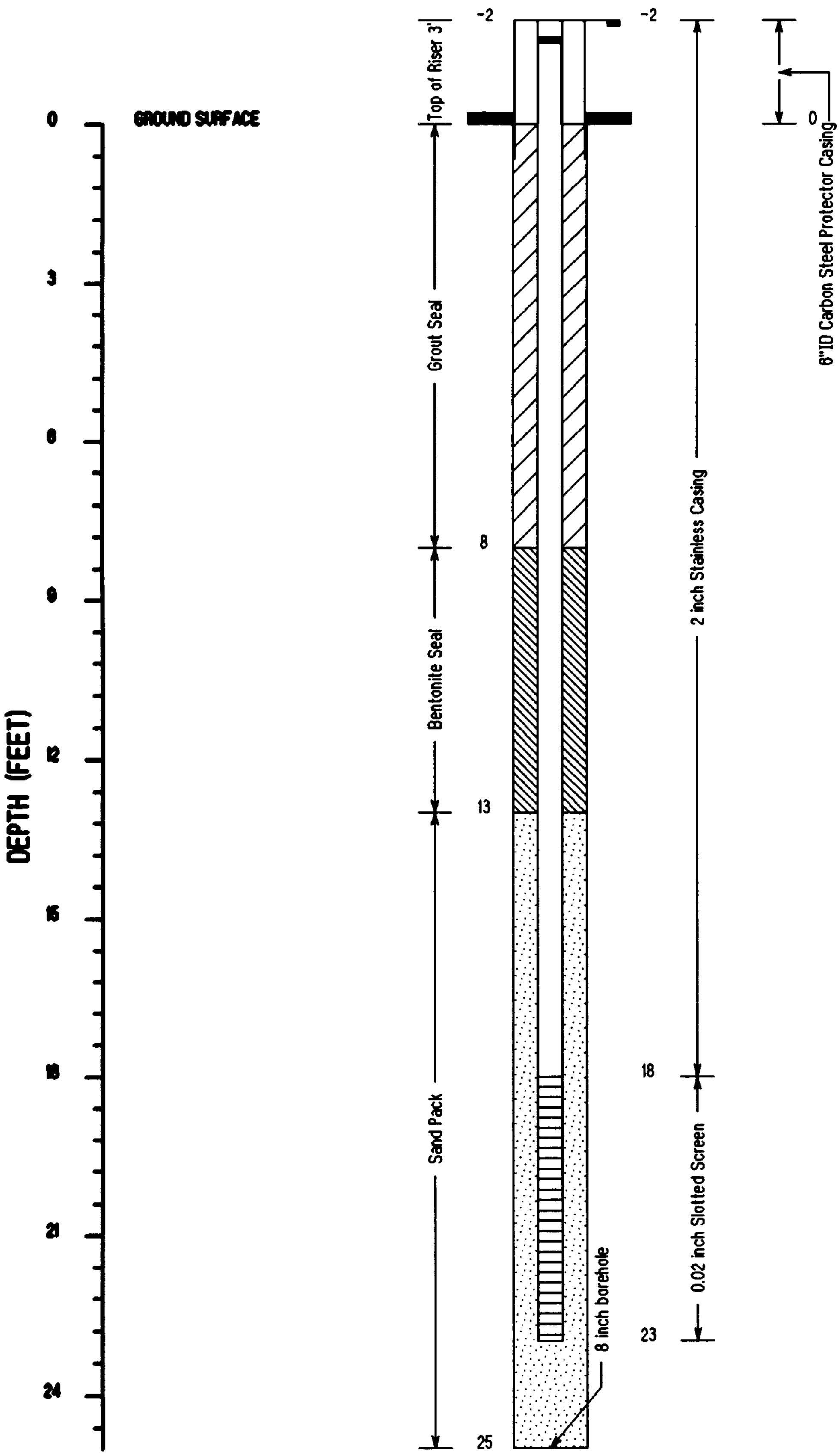
(See Logbook # 24)



WELL CONSTRUCTION DETAILS
WELL MW-185
ELEVATION: 2" TOC 373.64 ft. MSL

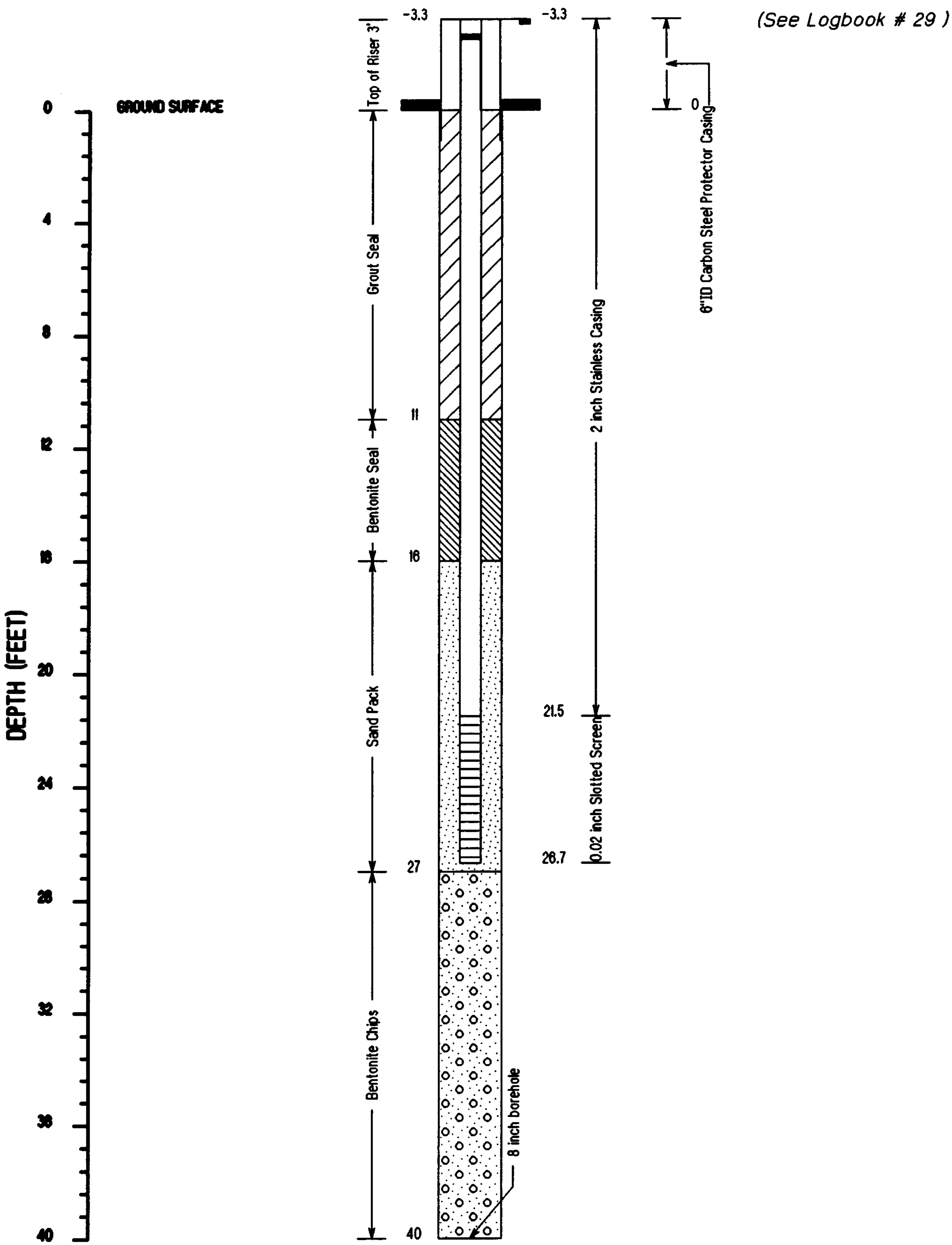
PGDP Phase II Site Investigation
WMU-7 Burial Ground

(See Logbook # 24)



WELL CONSTRUCTION DETAILS
WELL MW-186
ELEVATION: 2" TOC 373.62 ft. MSL

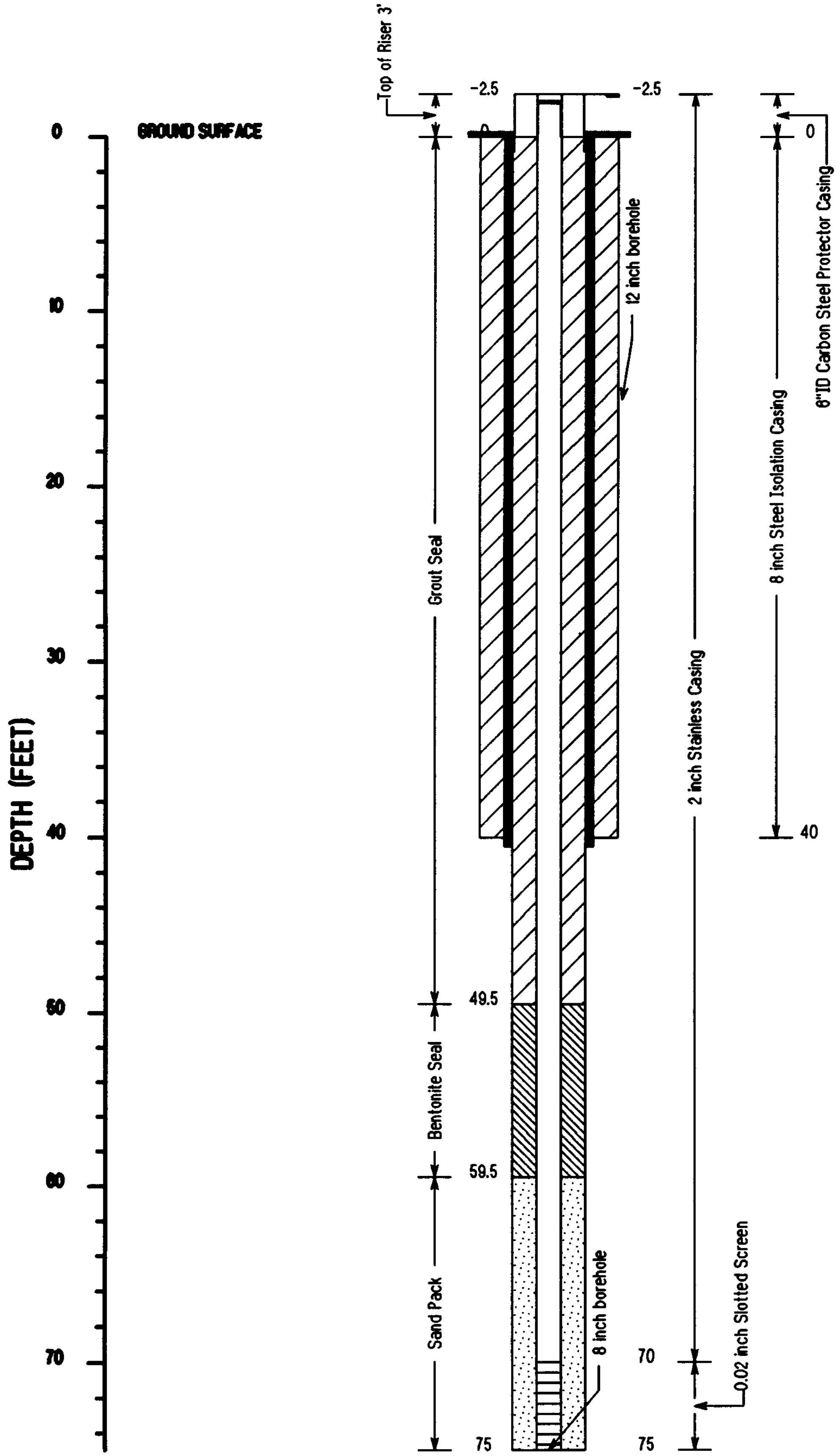
PGDP Phase II Site Investigation
WMU-7 Burial Ground



WELL CONSTRUCTION DETAILS
WELL MW-187
ELEVATION: 2" TOC 373.24 ft. MSL

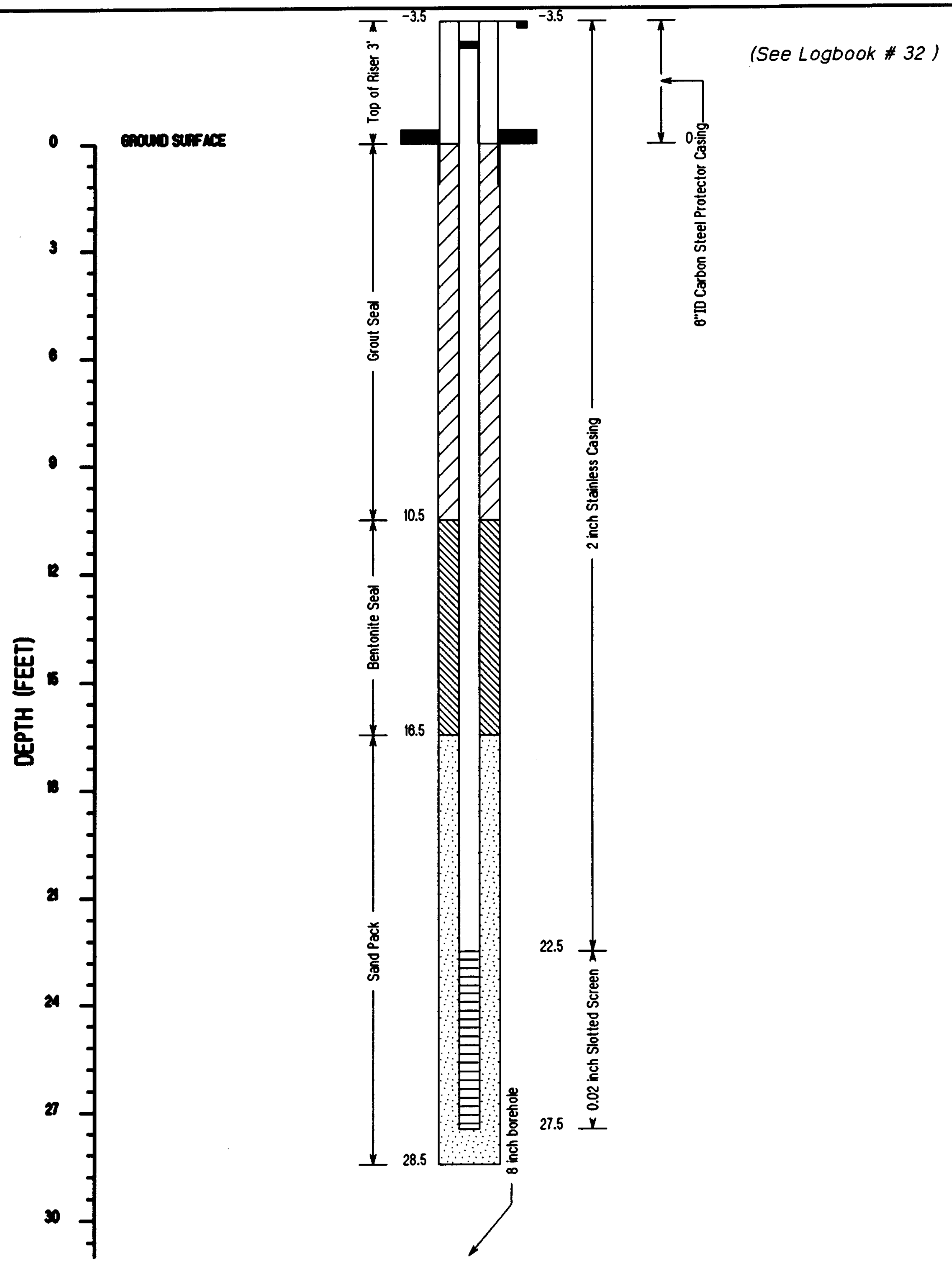
PGDP Phase II Site Investigation
WMU-30, Burn Area, with MW-66

(See Logbook # 32)



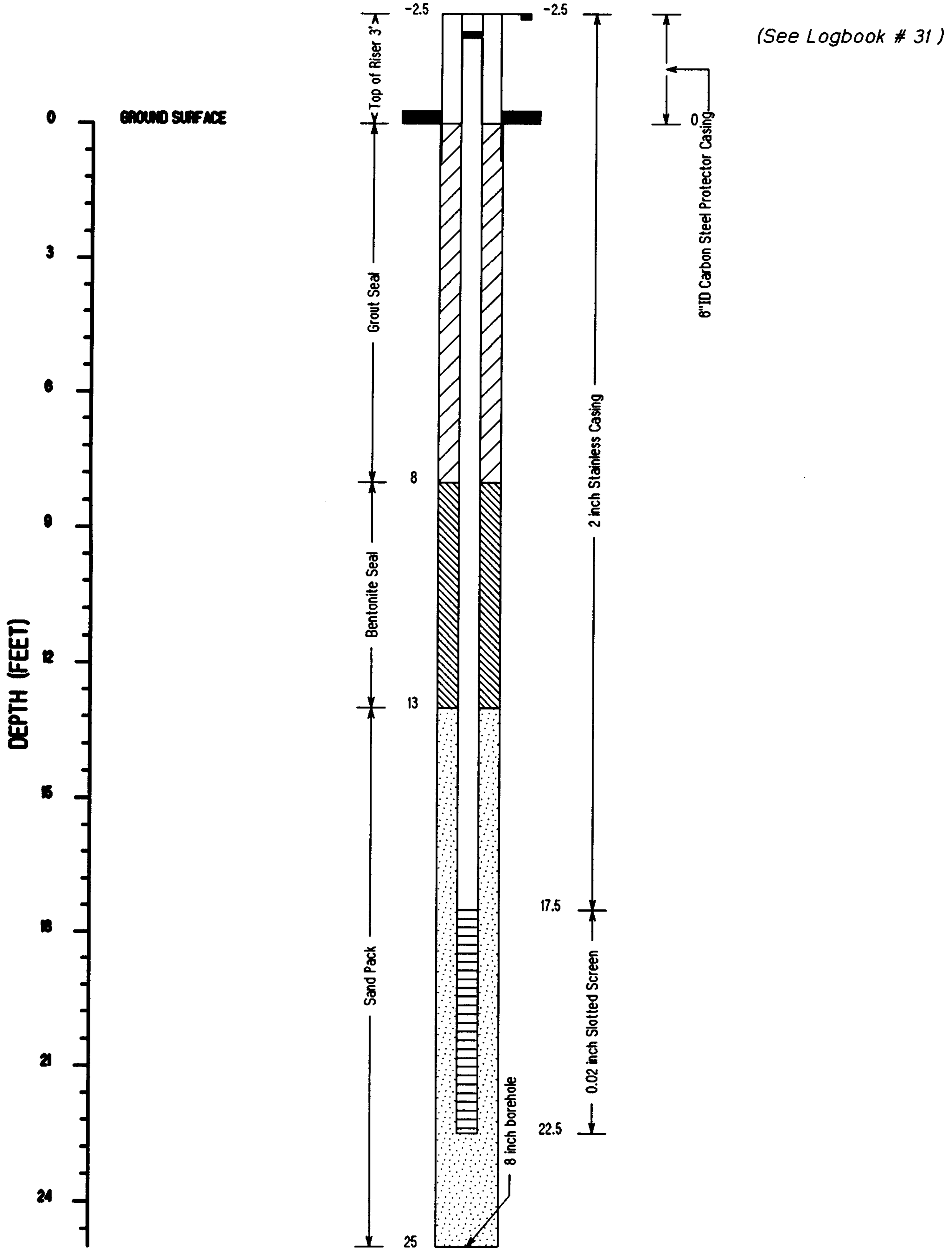
WELL CONSTRUCTION DETAILS
WELL MW-188
ELEVATION: 2" TOC 374.24 ft. MSL

PGDP Phase II Site Investigation
WMU-1, SW of Oil Landform



WELL CONSTRUCTION DETAILS
WELL MW-189
ELEVATION: 2" TOC 375.50 ft. MSL

PGDP Phase II
Paducah, Kentucky



WELL CONSTRUCTION DETAILS
WELL MW-190
ELEVATION: 2" TOC 373.20 ft. MSL

PGDP Phase II Site Investigation
North of Classified Burial Yard

APPENDIX 2B-5

Well Installation, Development, and Soil and Water Sampling: Stage B Monitoring Wells MW-191 through MW-206 and Exploratory Borings H266 through H272

PREPARED BY: Gennaro Avolio/ORO

SUBJECT: Well Installation, Development, Soil and Water Sampling: Stage B Monitoring Wells, MW-191 through MW-206 and Exploratory Borings H266 through H272

PROJECT: ORO30888.BI

INTRODUCTION

PURPOSE AND SCOPE

This technical memorandum documents the drilling and installation of 16 Stage B monitoring wells and the drilling of 6 exploratory borings for the Phase II Site Investigation at the Paducah Gaseous Diffusion Plant (PGDP). This memorandum is organized to present the background, rationale, and results for the Stage B monitoring well program; to discuss well locations; to describe methodologies for drilling, borehole logging, soil sampling, water sampling, well installation, and well development; to describe soil borings; to describe equipment decontamination procedures; and to describe the management of wastes derived from this task.

BACKGROUND

This monitoring well installation program augments an ongoing DOE/Energy Systems Environmental Restoration Program (ERP) to meet the objectives of an EPA and DOE Consent Order to determine the nature, extent, and threat of offsite groundwater contamination caused by sources at the PGDP.

Phase I, which has been completed, focused on evaluating the nature of offsite contamination originating at the PGDP. Results indicate that Tc-99 and BTEX compounds were detected, but not confirmed, in the deep groundwater system; TCE and Tc-99 concentrations were variable, but indicate plume(s) migrating offsite in the regional gravel aquifer. These contaminants were also detected in the shallow groundwater system adjacent to streams and in cultivated fields.

Phase II of the PGDP investigation is being carried out in two stages. Stage A included the installation of 35 wells at the onsite waste management units (See TM 4). This technical memorandum pertains to the Stage B monitoring well installation task. The objective for Phase II, Stage B, is to further define the vertical and lateral extent of the Tc-99 and TCE plume(s) in the groundwater by characterizing the water quality downgradient of the PGDP. To this end, 12 monitoring wells were installed offsite. Four of the additional wells were installed onsite, adjacent to identified waste management units (WMUs), to augment Stage A wells in characterizing potential sources of onsite contamination. Monitoring wells MW-203 and MW-204 were installed during Phase II, Stage B, as a result of Stage A sample results indicating a need to evaluate the C-720 building area as a possible source of contamination. In addition, monitoring wells MW-205 and MW-206 were installed during Phase II, Stage B, at the request of Energy Systems to further define possible contaminant migration between the C400 area and the plant periphery.

Data collected during the well installation include lithologic logs and field instrument screens for radiologic and volatile organic contaminants from soil samples. This data is presented herein. Data resulting from the well installation task will include laboratory chemical and radiological analysis of soil and groundwater samples collected from well boreholes and the developed monitoring wells, respectively, and slug test hydraulic parameters. This data is discussed in the Phase II Site Investigation Report.

Isolation casings were installed for monitoring wells MW-191, MW-192, MW-194, MW-197, MW-200, MW-202, MW-203, MW-205 and MW-206.

Wells were installed using truck-mounted CME drill rigs operated by Brotcke Engineering Co., Inc. (St. Louis, MO). During monitoring well installation, a hydrogeologist/geotechnical engineer from CH2M HILL and an industrial hygiene/health physics (IH/HP) technician from TMA/Eberline were present, providing technical supervision and health and safety monitoring. Field information for each well cluster, including personnel present, installation dates, development dates, drill rigs, and equipment used are included in Attachment 5-A.

WELL LOCATIONS

Monitoring well locations are shown in Figure 5-1. Well locations were selected to provide information regarding subsurface hydrogeologic setting, the vertical and lateral extent of the Tc-99 and TCE plume(s) in the groundwater, and the water quality downgradient of the PGDP. Table 5-1 lists the well locations, well numbers, plant coordinates, estimated ground elevation, hydrogeologic unit, screened interval (ft bgs), and rationale for the well location.

The 2-in. diameter, stainless steel wells were selected to allow groundwater sampling and to allow variable head tests for hydraulic properties analysis, while minimizing the volume of waste soils and purgewater generated.

Phase II, Stage B, wells were installed in two aquifers: the Shallow Groundwater System contained within sand of the Upper Continental Deposits, and the Regional Gravel Aquifer, which consists of sand and gravel designated as the Lower Continental Deposits. These aquifer zones were targeted, since they would provide data to further define the extent of the TCE and Tc-99 contaminants plume(s) offsite.

Five monitoring wells were installed within the Shallow Groundwater System, determined in the field as the uppermost saturated zone. This zone generally appears semi-confined beneath 15 to 25 ft of clay.

Ten monitoring wells were installed within the upper part of the gravel aquifer. Generally, these wells were installed just below the upper part of the RGA to secure proper development of these wells. This aquifer is the primary pathway of offsite groundwater contaminant transport. Site lithologic logs and downward vertical gradients suggest that the RGA is not hydraulically isolated from the shallow groundwater system.

Isolation casings were set for eight monitor wells in Stage B. Task instructions (March 22, 1991) specified that the isolation casings would be set in the fine-grained deposits near the base of the Upper Continental Deposits, if a well was to be completed (screened) within the RGA, and would penetrate a zone of possible contamination. Some monitoring wells were installed in clusters, and wells were designed based upon information collected during lithologic logging of the deepest borehole at each well cluster location

Stage B wells were screened over a 5-ft interval, except for MW-206, which has a 10-ft screen. The 10-ft screen was installed to expedite the construction schedule. Discrete well screen intervals were selected so as to screen only the permeable sand within the Upper Continental Deposits and in the upper portions of the RGA. This will allow checking of water quality and water level variations in discrete zones of each aquifer.

The ground elevation at Stage B wells has been estimated from the surveyed elevation of the monitor well riser, with the measured height of the riser being subtracted from the riser elevation. This elevation, because of the accuracy of the stick-up measurements, is shown to the nearest one-half foot. As the pads around the wells are completed, the elevation of the pad will be surveyed.

METHODOLOGY

DRILLING

Drill rigs were mobilized to the PGDP site on November 26, 1990, to commence drilling activities for Phase II, Stage A. Initial rig inspection (by Energy Systems) and decontamination of rigs, tools, and downhole equipment was performed from November 26 through 28.

Drilling for Stage B of Phase II started on March 7, 1991. The drill rigs were decontaminated before moving to a new well, or well cluster, location. Tools and downhole equipment were decontaminated between each borehole, and after setting an isolation casing, before continuing to drill below the isolation casing.

Drill rigs were set up on staked locations approved by Energy Systems under an excavation permit. At some drilling locations, such as within a radiation control zone or near high tension power lines, a radiation work permit, or a hazardous work permit, was required as determined by Energy Systems. Conditions of each of these permits were discussed with the crews working at the permitted location before work began.

A gravel working pad approximately 30 ft x 40 ft was constructed at most drilling locations to facilitate access and to help prevent the spread of contamination. Gravel pads were not constructed at MW-203 and MW-204, as these locations were mostly paved, nor at either MW-205 or MW-206, because the ground was dry and firm.

Prior to drilling, an exclusion zone was established to control access into and out of the working area. The exclusion zone was established using reinforced steel bar stakes and flagging to create a boundary. Level D personal protection was required to enter the exclusion zone. After drilling began, all persons and equipment were monitored by the IH/HP for radioactive contamination before leaving the exclusion zone.

The exclusion zone was enclosed by an outer zone (construction zone). The outer zone was large enough to contain any item falling from the drill rig mast. It also served as a corridor for the driller's equipment trucks and trailers to drop off and remove supplies. Level D personal protection was required to enter the outer zone. No monitoring was required to leave this zone.

Drilling was conducted by two truck-mounted CME 75 rigs and one truck-mounted CME 55 rig. Seven and three-quarter inch outer-diameter (OD) hollow stem augers (HSA) [3-3/4 in. inner-diameter (ID)] were used to drill and sample boreholes that were to receive 2-in. ID well strings. Twelve inch flight augers were used to ream the 7-3/4 in. boreholes to set 8-in. OD isolation casings.

Some RGA wells (MW-191, MW-192, MW-193, MW-194, MW-197, MW-200, MW-202, MW-203, MW-205 and MW-206) have an 8-in. OD, steel isolation casing installed to the depth of a fine-grained soil interval, located between possible saturated zones in the Upper Continental Deposits and the RGA (see Table 5-1 for depths). The casing was installed inside a 12-in. ID borehole, and the 4-in. annular space was grouted using a tremie pipe. No further drilling was conducted until the grout set overnight.

The next day, the RGA borehole was advanced to total depth (inside the isolation casing), either the top of the RGA or the bottom of the RGA. The RGA was easily identified during drilling by a "chattering" of the drill rig and/or by a significant decrease in sample recovery from the continuous sampler due to large size gravel (up to approximately 1.5- to 2-in. in diameter).

The drilling sequence at a well cluster with a shallow water table well and an RGA well was as follows: On the RGA well location, a 7-3/4 in. borehole was advanced and continuously sampled with a 5-ft x 3-in. ID, CME continuous sampler to the depth of

TABLE 5-1
Stage B Monitoring Well Data
PGDP Phase II Site Investigation

Well Location	Well No.	Approximate Plant Coordinates	Ground Elevation and Isolation Casing Depth	Hydrogeologic Unit	Screened Interval (ft bgs)	Reasons for Well Locations
Offsite–Ogden Landing Road and Little Bayou Creek	MW191	N (600.3) E (2597.4)	357.12 46	Upper RGA	55–60	Eastern Boundary Definition
Offsite–Ogden Landing Road and Little Bayou Creek	MW192	N (600.4) E (2587.8)	356.9 31	SGS	38–43	Eastern Boundary Definition
Offsite–Ogden Landing Road and Power Lines	MW193	N (3064.9) E (515.8)	366.24	Upper RGA	63–68	Eastern Boundary Definition
Offsite–next to Big Bayou Creek	MW194	N (1865.6) E (–10177.5)	353.76 21	Upper RGA	47–52	Western Boundary Definition
Offsite–next to Big Bayou Creek	MW195	N (1861.1) E (–10193.4)	354.03	SGS	6–11	Western Boundary Definition
Offsite–So. of Plant on Hobbs Rd.	MW196	N (–7987.3) E (–4977.8)	387.47	SGS	21.9–26.9	Background
Offsite–M6 Road North of Plant	MW197	N (2863.1) E (–6162.5)	366.54 26	Upper RGA	58–63	Plume Definition North
Offsite–M6 Road North of Plant	MW198	N (2874.8) E (–6163.0)	366.61	SGS	18–23	Plume Definition North
Offsite– North of Ogden Landing Road	MW199	N (10090.1) E (–10076.6)	353.87	Upper RGA	57–62	Northwestern Boundary Definition
Offsite–Boldry School Road	MW200	N (4443.3) E (–4823.9)	377.11 31	Upper RGA	74–79	Plume Definition North
Offsite– Boldry School Road North of Plant	MW201	N (10167.4) E (–4884.0)	364.51	Upper RGA	62.5–67.5	Northern Boundary Definition
Offsite–North End of M7 Road	MW202	N (7613.2) E (–5688.0)	370.53 31	Upper RGA	77–82	Northern Boundary Definition
North of C–720 Building	MW203	N (–2159.2) E (–5014.8)	374.95 31	Upper RGA	71–76	Characterize 720 Bldg
North of C–720 Building	MW204	N (–2148.1) E (5014.1)	374.84	SGS	49.4–54.4	Characterize 720 Bldg
East of C–335 Building	MW205	N (–364.1) E (–4360.3)	377.22 36	Upper RGA	65–70	Define Cotaminant Migration
South of C–631 Building	MW206	N (–1504.8) E (–2924.5)	382.95 46	Upper RGA	67–77	Define Cotaminant Migration

RGA= Regional Gravel Aquifer
SGS = Shallow Groundwater System

the isolation casing (typically 30 to 50 ft). The borehole was reamed and cleaned out using the 12-in. flight augers. These augers were then removed from the hole (in most instances, the hole stayed open due to the high percentage of clay or stable formation in the upper 50 ft) and the 8-in. isolation casing was placed into the bottom of the reamed 12-in. borehole. The isolation casing was grouted in place using a tremie pipe and allowed to set overnight before continuing to drill. The next day, 7-3/4 in. augers were advanced inside the 8-in. isolation casing to the total RGA well depth while collecting continuous samples. All samples were collected using the 5-ft continuous sampler. After the RGA well was installed, the shallow borehole was drilled using the 7-3/4 in. hollow stem augers to the total well depth, as determined from the lithologic log of the RGA borehole. Typically, no sampling was conducted in the shallow borehole at a clusterlocation.

BOREHOLE LOGGING

The Sample Team Leader (STL) logged the boreholes during drilling. Descriptions of the soil collected during drilling and sampling were recorded on standard form D1586 in accordance with CH2M HILL's "Standard Procedures for Logging of Soil Borings" (January 26, 1990). The soil boring logs are included as Attachment 5-B. These logs correspond to the deepest borehole at each well cluster (Table 5-1). Logged information, in addition to lithologic descriptions, include HNu and radiological field readings, and pocket penetrometer values for recovered samples.

In addition to the borehole logs, the STL kept a field logbook that contains a chronologic diary of the work completed each day at a given well location. Logbook reference numbers are indicated on the well completion diagrams in Attachment 5-C. These books contain the names of personnel on site, descriptions of the field methods, any unusual or notable occurrences during the work, diagrams of the installed wells, tables of materials installed and removed from the well borehole, and tables of waste drum numbers used to contain wastes from the well cluster.

SOIL SAMPLING

Soil samples were collected continuously in the deepest borehole at each well location. Samples were obtained using a 5-ft long, 3-in. ID split barrel, stainless steel, CME continuous sampler that provided continuous soil sampling during hollow auger drilling. The sampling barrel fits within the lead auger, extending a short distance in front of the auger head, allowing sampling to occur slightly in advance of the augers. The Task Instructions required continuous soil samples to the top of the RGA, and then at 5-ft intervals, thereafter. Because a CME continuous sampler was used, samples were collected continuously to the total depth. All soil samples were screened with the HNu for volatile compounds and with an AC-3 Alpha Probe and HP-210 or HP-260, Gamma Probe for radioactivity, then lithologically logged. Well screen locations were chosen based upon soil sample lithology.

The exploratory borings were drilled and sampled the same as for a monitoring well with exception that the samples were not retained after field logging but were drummed with the cuttings. When the RGA was reached, a water sample was obtained for delivery to PGDP.

One investigation-derived waste sample was composited over the entire depth of the deepest well cluster borehole for laboratory analysis to determine if drummed soil cuttings should be handled as hazardous material. Several spoonfuls of soil along the length of each continuous sample were placed into a stainless steel bucket. After the borehole reached total depth, the soil in the bucket was mixed and transferred to sample jars in the following aliquots:

- 60-ml glass jar for radioactivity analysis

- (6) 32-oz glass jars for VOAs, TCLP, TCLP metals, PCBs/pentachlorophenol, radioisotopes, and general waste characteristics

WELL INSTALLATION

Lithologic logs (Attachment 5-B) from the deepest boring at each site were used to select the screen interval(s), the isolation casing depth (if applicable), and the total well depth(s). STLs submitted daily copies of lithologic logs and the field logbook to the Task Manager. Based upon daily submittals of lithologic logs, and information relayed from the field by the STL, the Task Manager, in consultation with the STL specified the screen interval for each Stage B monitoring well.

Wells were installed by three separate field crews under the field direction of a CH2M HILL STL (geotechnical engineer or hydrogeologist). Approved well construction materials were supplied by Brotcke Engineering and checked and noted in the field by the STL for conformance with specifications. Well construction diagrams are included in Attachment 5-C.

The well boreholes were drilled a few feet below the depth at which the well screen was to be placed. This allowed for caving of the formation before the well string was installed and for attempted placement of some filter pack below the well screen.

The 2-in. ID well string was installed inside the 7-3/4 in. hollow stem augers to the depth interval specified by the Task Manager. The well string consisted of, from bottom to top, a 2-in. end cap, a 5-ft length of 0.01-in. slot Johnson Channel Pack screen, and the appropriate length of riser to allow 2- to 3.5-ft above the ground. Channel Pack screen is a prepacked screen assembly with a built in filter pack. The filter pack used was 16-30 mesh Colorado Silica sand. The pre-packed screen assembly consists of an inner screen and an annular outer screen with the designed filter pack in the space between the two screens. The top and bottom of the assembly is closed so the filter is confined to the screen area.

The screen length for MW-206 was 10 ft instead of the usual 5 ft. This change was made to expedite the construction schedule. The well string material is Johnson type 304 stainless steel, and is joined by factory threaded ends with chemically inert O-rings for sealing.

Once the well string was placed, a filter pack was installed from the bottom of the borehole to a depth 5 ft above the well screen. The filter pack consisted of 16-30 mesh Colorado Silica sand. The filter pack was placed because the Channel Pack extended only to the top of the screen.

Above the filter pack, a minimum 4-ft thick bentonite seal was placed in the borehole. The seal was placed with a tremie pipe, using a 1:1 mixture of Naturalgel powdered Wyoming bentonite and potable water. The thickness of this seal was nominally 5 ft. Because the bentonite seal was placed as a hydrated slurry, there was no setting time before placing the grout above the bentonite seal. Because it was difficult to measure the depth of the hydrated bentonite seal with a weighted tape, an approximate volume of one and one-half bags of bentonite and 8 gal of water was mixed in the grout plant and pumped via a 1/4-in. tremie pipe into the annular space. This produced an approximate 5-ft seal.

The annular space from above the bentonite seal to the ground surface was grouted using 1-in. diameter PVC tremie pipe or 1-in. flexible plastic tubing. Lonestar Type I portland cement was mixed in batches consisting of approximately two bags of cement, 15 gal of potable water, and one-fourth bag of bentonite. The grout was mixed in a grout plant and pumped through the tremie pipe into the borehole.

The monitoring wells were installed and developed before concrete pads, posts, and protective casings were installed. Protective casings were constructed of 6.625-in. OD, ASTM A53, Grade B steel with hinged locking caps. The protective casings were approximately 6 ft in length with approximately 3 ft installed and grouted below ground surface so there were 4 in. between the top of the well riser and the top of the protective casing. The protective casings are set into a 4 ft square reinforced concrete pad approximately 1-ft thick. The wells were further protected by installing four 3-ft high guard posts at corners 5 ft away from the well. Guard posts consisted of the same steel pipe as the protective casing installed approximately 3 ft below ground surface and filled with cement. Protective casings and posts were painted a bright yellow color, similar to the color of the wells installed during Phase I of the PGDP Investigation.

On the north side of the concrete pad, two circular brass plates were installed in the concrete at the base of the protective casing. The well identification number is inscribed on the plates with the surveyed well coordinates and the elevation of the brass plates.

WELL DEVELOPMENT

Stage B wells were developed from March 13, 1991, to May 14, 1991. The development procedure involved surging, bailing, and airlift pumping so that representative formation water may be subsequently sampled from the wells. Wells screened within the shallow aquifer were only surged and bailed because airlift methods could not be employed due to low water volume and depth. Wells were developed using the procedures in Energy Systems Method ESP-600.

The sequential well development procedure was the following: Each well was sounded for total depth and water level, and most were then surged with a stainless steel surge block throughout the screen interval. Each 1-ft increment of well screen was surged for approximately 15 to 20 min using a consistent up and down motion drawing fine sediments into the well screen by suction of the surge block inside the screen.

After surging, the well was bailed using a stainless steel bailer to remove accumulated sediments. If more than 1 ft of sediments was measured within the well, bailing was continued until the water removed contained less than 10% sediments, as determined by visually assessing a 5-gal bucket of bailed water that was allowed to settle. If less than 1 ft of sediment was measured in the well, then air lift pumping was initiated on the RGA wells to complete the well development. For shallow wells, bailing was continued until criteria for well development listed below was met and the Task Manager and STL approved the completion of development for that well.

Well development was complete when a minimum of 5 times the casing volume plus the water added to the well was removed, field parameters of conductivity and pH were stable, and the water had cleared sufficiently, or, if water was still turbid, the Task Manager and the STL approved the completion of development. Field parameters were considered stable when pH varied by less than 0.5 units, temperature varied less than one degree, and specific conductivity varied by less than 10% over three consecutive water samples.

The total volume of water removed from each well and the values of stabilized field parameters are shown in Table 5-2. The total volume of water removed from each well was generally greater than the criteria specified above because five volumes were frequently not sufficient to result in clear well water. Clear water was defined as light pink, or clearer, in color as observed in a white 5-gal bucket. In general, the water pumped from the RGA wells became clear. However, the shallow wells often did not produce enough water to achieve clarity by bailing. Shallow wells were bailed at intervals of time until the specified volume was removed, the parameters stabilized, and the Task Manager and STL approved the completion of development based upon the hours spent, volume removed, rate of well recovery, and water color descriptions.

Following development, groundwater sampling began. The first set of samples were collected starting April 1, 1991.

TABLE 5-2
Stage B Monitoring Well Development Data
PGDP Phase II Site Investigation

Well ID	Well Screen Zone	Gals. Removed	Hrs. Surge/ Bail	Hrs. Pump	Parameters pH (SU)	Cond. (Umho)	Temp. (°C)	Color	Development Start	Completion	Comments 15 min Recovery per 5 ft.
MW-191	RGA	300	2.5	6	7.59	315	16		3/15/91	3/20/91	
	57.5-62.5				7.63	320	15.5				
					7.66	320	15.5	Clear			
MW-192	SGS?	55	10	0	6.90	365	16				
	40-45				7.04	365	16				
					7.14	365	16	Cloudy	3/15/91	3/20/91	Yes
MW-193	RGA	400	2.5	10	7.22	340	20				
	63-68				7.29	335	20				
					7.26	335	20	Clear	4/30/81	5/2/91	Yes
MW-194	RGA	220	2.5	5	7.04	185	12				
	50-55				6.98	180	12				
					7.01	180	12	Clear	3/13/91	3/15/91	
MW-195	SGS	50	5	0	7.04	100	11				
	7-12				6.98	100	11				
					6.48	95	10	Cloudy	3/13/91	3/15/91	Yes
MW-196	SGS	35	5.5		6.11	560	17				
	25-30				6.24	560	16				
					6.29	560	15.5	Cloudy	3/20/91	3/21/91	Yes
MW-197	RGA	150	2.5	9	6.70	265	15				
	60-65				7.62	355	14				
					7.37	355	14	V. Clear	3/26/91	3/28/91	
MW-198	SGS	40	6	0	6.95	590	16				
	20-25				7.07	580	15				
					7.13	580	15	Cloudy	3/26/91	3/28/91	
MW-199	RGA	110	1.5	3	6.30	352	16.5				
					6.50	350	17				
					6.50	349	16.5	Cloudy	5/13/91	5/14/91	
MW-200	RGA	300	2.5	11.5	6.93	300	21				
	75-80				6.97	310	21				
					7.04	315	21	V. Clear	3/21/91	3/25/91	
MW-201	RGA	122	5	18	6.87	360	15.5				
	65-70				6.90	355	15				
					6.86	355	15	Clear	4/1/91	4/5/91	
MW-202	RGA	185	2.5	8.5	6.76	275	21				
	80-85				7.01	270	20				
					7.06	270	20	V. Clear	3/29/91	4/1/91	
MW-203	RGA	580	2.5	22	6.83	350	25				
	73-78				7.00	340	23.5				
					7.01	345	24	Clear	4/9/91	4/17/91	
MW-204	SGS	65	2.5	10	6.14	570	21				
	52-57				6.13	565	21	Cloudy,			
					6.09	565	21	Clearing	4/9/91	4/17/91	
MW-205	RGA	150	1.5	23	7.22	310	23				
	65-70				7.18	310	23				
					7.20	310	23	Dark	5/9/91	5/11/91	
MW-206	RGA	150	3	12	8.05	580	23				
	67-77				7.98	585	23				
					8.03	580	23	Clear	5/11/91	5/14/91	

EXPLORATORY BORINGS

During the PGDP Phase II, Stage B site investigation, six exploratory borings were drilled off site. The location of these borings are shown in Figure 5-1. The purpose for drilling these exploratory borings was to determine the locations of MW-201 and MW-202 so that these two wells would be at the locations with the highest levels of contaminates as determined from water samples taken from the exploratory borings.

Table 5-3 presents location, depth, and subsurface data about the exploratory borings. Two of these borings, H-267 and H-268, were drilled to the bottom of the RGA at the request of Energy Systems. Boring H-267, located at the northernmost end of M-7 road in the WKWMA, shows the top of sand identified at 50 ft, top of gravel at 75 ft, and bottom of gravel at 95 ft. The last sample attempted on this boring had poor recovery, believed to be caused by the loose gravel encountered at 85 ft, which caused the sample not to stay in the sampler. The interface depth was determined, in part, by the drilling manner. At Boring H-268, located 500 ft east of Bouldry School Road on Jim Allen Road, the top of sand was identified at 54 ft, top of gravel at 65 ft, and bottom of gravel at 86 ft.

Water samples were taken at the request of Energy Systems from the six borings once the RGA was reached. A stainless steel bailer was inserted through the hollow stem auger for the collection of the water sample. The bailer was decontaminated as per specifications listed below under the "Decontamination of Equipment" section. These water samples, which were submitted directly to Energy Systems for analysis of TCE and Tc-99, consisted of two 250-cc bottles. The results from these water samples (shown on Table 5-3) were used to determine the location of monitor wells MW-201 and MW-202.

Monitoring well MW-201 was drilled at the exploratory boring H-271 location and monitoring well MW-202 was drilled at the exploratory boring H-267 location.

DECONTAMINATION OF EQUIPMENT

The purpose of consistent decontamination procedures is to prevent the spread of possibly contaminated material between boreholes and samples and from the immediate work area around the well borehole.

Drilling and sampling equipment was decontaminated in accordance with Energy Systems Methods ESP-900 and ESP-901. Before setting up at a drilling location, a drill rig was decontaminated by steam cleaning according to ESP-901. The drill rig was steam cleaned between well clusters and not between wells within a cluster. Steam cleaning took place at the off-site decontamination pad.

Downhole equipment (drill rods, bits, augers, samplers, etc.) were decontaminated according to ESP-900 as follows: (1) detergent/potable water wash, (2) potable tap water rinse, (3) organic-free water rinse, (4) isopropanol rinse, (5) organic-free water

TABLE 5–3
Stage B Exploratory Boring Location Data
PGDP Phase II Site Investigation

Exploratory Boring No.	Exploratory Boring Location	Approximate Plant Coordinates	Estimated Ground Elevation (Top of Borehole ft. msl)	TCE and TC–99	Reason for Exploratory Boring
H–266	North End of M–4 Road	N (7688.9) E (–6993.3)	366.08	<1 ppb <25 pCi/l	Location of ground water contamination for monitor well location.
H–267	North End of M–7 Road	N (76132.2) E (–56880)	370.53	46 ppb 37 pCi/l	Location of ground water contamination for monitor well location. MW–202 located here.
H–268	West End of Jim Allen Road	N (8008.3795) E (–4346.1652)	367.37	2 ppb <25 pCi/l	Location of ground water contamination for monitor well location.
H–270	Old Raw Water Line	N (10418.0125) E (–3558.8014)	360.73	30 ppb <25 pCi/l	Location of ground water contamination for monitor well location.
H–271	Boldry School Road North of Plant	N (10167.4) E (–4884.0)	364.51	86 ppb 35 pCi/l	Location of ground water contamination for monitor well location. MW–201 located here.
H–272	North End of North Extension of Harmony Cemetery Road	N (8549.369) E (–3211.0236)	361.51	<1 ppb <25 pCi/l	Location of ground water contamination for monitor well location.

ppb= Parts per Billion
pCi/l= Pico Curies per Liter

rinse, and (6) air drying. Downhole and soiled equipment (i.e., hoses, pipe wrenches, tools) were decontaminated between each well location at the off-site decontamination pad.

Of the downhole equipment, soil samplers were decontaminated in the field at the drill site using a metal trough to collect the decon water. Samplers were laid on a screen over the trough, and stainless steel, pressurized sprayers containing detergent, potable water, organic-free water, and isopropanol were used with brushes to clean the samplers at the site. After cleaning and air-drying, the samplers were scanned by the IH/HP technician with an HNu for a final check before reentering the borehole.

The remainder of the downhole equipment was wrapped in plastic, loaded on a trailer, and not decontaminated in the field but decontaminated at the decontamination pad. Decontaminated equipment was then wrapped in plastic and transported to the drill site. There was no IH/HP coverage at the offsite decontamination pad to scan all decontaminated equipment. However, team members visually inspected and scanned the equipment as it was used at a new borehole or below the isolation casing.

STLs were responsible for preventing contamination of samples collected for laboratory analysis. Disposable plastic sheeting was laid underneath tables and around the borehole to catch soils dropped on the ground. Stainless steel bowls and implements for mixing and collecting samples were decontaminated either at the decontamination pad or drill site between samples. Bailers used for the collection of water samples at the exploratory boring locations were decontaminated by steam cleaning at the off-site decontamination pad.

Personal protective equipment (PPE) and other disposable items were disposed of into labeled PPE drums before leaving the exclusion zone at a drill site.

INVESTIGATION-DERIVED WASTE MANAGEMENT

Potentially hazardous wastes generated during the Stage B well installation task include borehole soils (drill cuttings); disposable equipment (PPE); and fluids removed from the borehole, the well, or generated by decontaminating equipment. These wastes were segregated by type (soils, PPE, and waste water) and by location. All investigation-derived waste was relinquished to Energy Systems.

Soils, or drill cuttings, were contained and segregated by well or borehole number; well development water was contained and segregated by well cluster and composited into 1,200-gal storage tanks at the PGDP Secured Storage Area (SSA), and field decontamination waste water was pumped into drums at the well site or transported to the offsite decon pad and pumped into decontamination water tanks. Ultimately, wastes were transported and stored in the SSA until undergoing chemical classification to determine their release by Energy Systems.

Brotcke Engineering was responsible for drumming wastes in 55-gal drums at a drill site and transporting drummed wastes from each well cluster location to the SSA. The Waste Manager assigned drum numbers to the STL, who labeled drums. Soils were shoveled from the metal plate around the borehole directly into lined, 55-gal drums. Well development water was either bailed into 55-gal drums, or pumped into 600-gal mobile tanks at the well cluster. Mobile tanks were transported to SSA and pumped, under the direction of the Waste Manager, into 1,200-gal storage tanks.

A waste composite sample, as described under the section, Soil Sampling, was collected by the STL at each single well or well cluster location.

INTERPRETATIONS

Data collected during Stage B well installation include lithologic logs and HNu and radiological screening data. During the installation of Stage B wells at MW-197 and MW-198, no good saturated zone was found in the Upper Continental Deposits. The screen for MW-198 was set with the bottom at 23 ft in a moist sand. Also at the location for MW-191 and MW-192, no shallow water zone was located. MW-192 was constructed with the screen from 38 to 43 ft. MW-191 and MW-192 are located immediately next to Little Bayou Creek, and previous creek erosion and deposition could have altered the stratigraphy here. Subsequent water level measurements will determine if this well is in the RGA.

Indicated on the boring logs are locations where soil sample(s) had Hnu or radiological screening data values greater than background. These locations may be checked against laboratory soil and groundwater data when they are available.

The well borehole logs generally correlate with borehole logs collected during the Phase I investigation (Phase I Site Investigation, March 22, 1991). In general, the boring logs reveal an uppermost stratigraphic unit consisting of a clay and clayey sand underlain by a silty clay. The silty clay has been identified by the U.S. Geological Survey as a wind blown loess. This two part unit can be up to 35-ft thick and is underlain by what is interpreted as Upper Continental Deposits. The Upper Continental Deposits here consist of alternating layers of sand (usually less than 5 ft) and clay or clayey sand (up to 50 ft) with some very thin layers of angular to sub angular gravel. The thin gravel layers, if present , are found near the top of the unit. The total depth to the bottom of the Upper Continental Deposits is 35 to 65 ft. In general, the Upper Continental Deposits contain the shallow groundwater system. Five monitoring wells were installed in the Shallow Groundwater System.

The Upper Continental Deposits are underlain by the Lower Continental Deposits of well-rounded, cherty gravel with varying amounts of non-cohesive silt and sand. The Lower Continental Deposits are the Regional Gravel Aquifer. Eleven monitoring wells were installed in the Regional Gravel Aquifer.

The Lower Continental Deposits are underlain by the Porters Creek Clay, the McNairy Formation, and Eocene Sand. No Phase II wells or borings penetrated these units, except MW-196 and exploratory borings H-267 and H-268.

Typically, except at MW-197, there were approximately 1 to 25 ft of loose sand directly underlying the clayey sand-sandy clay and above the regional gravel aquifer (RGA). This sand is considered part of the Upper Continental Deposits, although, according to the boring logs, no significant hydraulic barrier was encountered between the sand and the RGA. Because the sand was loose and wet, its occurrence was often marked by little to no sample recovery. Installing wells in areas where these non-cohesive sand was present sometimes presented difficulty. Sand would rise in the augers, requiring the driller to add water to the augers or attempt redrilling. The use of sand pre-packed screens for constructing Stage B monitoring wells made it easier to assure a sand pack around the monitor well screen.

The RGA, readily identified by loose sand and gravel, was encountered consistently at depths approximately between 47 ft bgs (MW-194) and 70 ft bgs (MW-206). The corresponding elevations were El. 307 and El. 314, respectively.

The base of the gravel aquifer was established at two locations: exploratory borings H-267 and H-268. The depth of the RGA base, as shown in the boring logs, was 95 ft at H-267, and 86 ft at H-268.

At monitoring well MW-196, the RGA was not encountered, and a black, lean clay, interpreted as Porters Creek Clay, was encountered at a depth of 26 ft.

REFERENCES

CH2M HILL. "Standard Procedures for Logging of Soil Borings". January 26, 1990.

CH2M HILL. "Phase II Site Investigation Work Plan for Paducah Gaseous Diffusion Plant". June, 1990.

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CH2M HILL. "Task Instructions for Phase II Monitoring Well Installation--Stage B". March 22, 1991.

CH2M HILL. "Technical Memorandum 5 PGDP Phase II Site Investigation". May 15, 1991.

U.S. Geological Survey Water Supply Paper 1987 "Subsurface Geology and Ground-Water Resources of the Jackson Purchase Region, Kentucky. 1973.

Energy Systems. "Environmental Surveillance Procedures--Quality Control Program." 1988.

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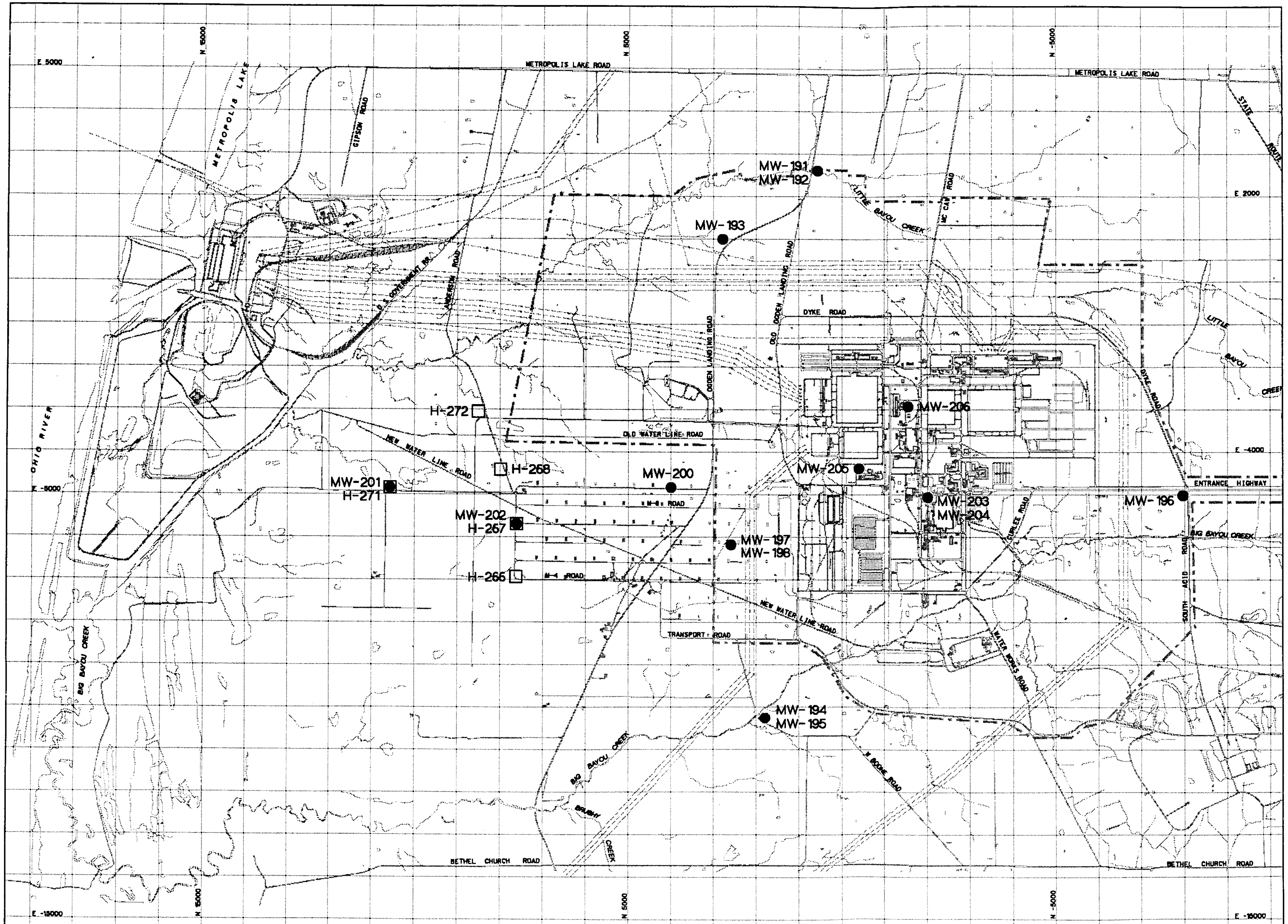


REVIEWED FOR CLASSIFICATION

LOS 7/9/03

Initials Date

UNCLASSIFIED

LEGEND

● MW-191 MONITORING WELL

□ H-266 EXPLORATORY BORING

PLANT NORTH

20°

TRUE NORTH

0 1250 2500 3750

SCALE 1" = 2500'

Figure 5-1

STAGE B MONITORING WELL LOCATIONS

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY.

PHASE II SITE INVESTIGATION

Attachment 5-A
FIELD EXPLORATION INFORMATION

ATTACHMENT 5-A
FIELD EXPLORATION INFORMATION FOR STAGE B
MONITOR WELLS AND EXPLORATORY SOIL BORINGS
PGDP PHASE II SITE INVESTIGATION

WELL/BORING	EQUIPMENT	ON-SITE PERSONNEL
MW-191 Installation: 03-13-91 TO 03-14-91 Development: 03-15-91 TO 03-20-91 Well TD = 61' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 61'	D. Geshwender (CH) D. Morrison (EB) C. Faus (BR) G. Shetley (BR) T. Childress (BR) R. Dependahl (BR)
MW-192 Installation: 03-07-91 to 03-08-91 Development: 03-15-91 TO 03-20-91 Well TD = 50' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 50'	D. Geshwender (CH) D. Morrison (EB) C. Faus (BR) G. Shetley (BR) T. Childress (BR) R. Dependahl (BR)
MW-193 Installation: 04-26-91 to '04-26-91 Development: 04-30-91 TO 05-02-91 Well TD = 70' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 70'	D. Geshwender (CH) D. Morrison (EB) G. Autry (BR) G. Shetley (BR) J. Lutman (BR) S. Umfleet (BR) R. Dependahl (BR)
MW-194 Installation: 03-07-91 to 03-08-91 Development: 03-13-91 TO 03-15-91 Well TD = 55' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 55'	J. Anderson (CH) A. Grigsby (EB) R. Holder (BR) R. Dependahl (BR) C. Thompson (BR) N. Risner (BR)
MW-195 Installation: 03-12-91 to 03-12-91 Development: 03-15-91 TO 03-20-91 Well TD = 17' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 17'	R. Holder (BR) N. Risner (BR) G. Shetley (BR) E. Pomar (CH) D. Frain (EB) B. York (CH) T. Boone (BR) R. Scott (BR) E. Downard (EB)
MW-196 Installation: 03-18-91 to 03-18-91 Development: 03-20-91 TO 03-21-91 Well TD = 30' bgs	CME 75; 7 3/4 OD Hollow Stem Auger; 30'	G. Schaefer (CH) A. Grigsby (EB) R. Holder (BR) N. Risner (EB) G. Shetley (BR)

WELL/BORING	EQUIPMENT	ON-SITE PERSONNEL
MW-197 Installation: 03-19-91 to 03-21-91 Development: 03-26-91 TO 03-28-91 Well TD = 65' bgs	CME 55; 7 3/4 OD Hollow Stem Auger; 65'	D. Geshwender (CH) D. Morrison (EB) G. Autry (BR) S. Umfleet (BR) C. Thompson (BR)
MW-198 Installation: 03-20-91 to 03-20-91 Development: 03-26-91 TO 03-28-91 Well TD = 25' bgs	CME 55; 7 3/4 OD Hollow Stem Auger; 25'	D. Geshwender (CH) D. Morrison (EB) G. Autry (BR) S. Umfleet (BR) C. Thompson (BR)
MW-199 Installation: 05-08-91 to 05-08-91 Development: 05-13-91 TO 05-14-91 Well TD = 65' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 65'	G. Schaefer (CH) D. Morrison (EB) J. Lutman (BR) S. Umfleet (BR) R. Dependahl (BR)
MW-200 Installation: 03-19-91 to 03-20-91 Development: 03-21-91 TO 03-25-91 Well TD = 80' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 80'	E. Pomar (CH) D. Frain (EB) C. Faus (BR) T. Childress (BR) R. Dependahl (BR)
MW-201 Installation: 03-25-91 to 03-26-91 Development: 04-01-91 TO 04-05-91 Well TD = 70' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 70'	D. Geshwender (CH) D. Morrison (EB) G. Autry (BR) S. Umfleet (BR) C. Thompson (BR)
H-270 Installation 03-18-91 TO 03-18-91 Boring TD = 60' bgs	CME 55; 7 3/4 OD Hollow Stem Auger 60'	E. Pomar (CH) D. Frain (EB) G. Autry (BR) S. Umfleet (BR) M. Umfleet (BR)
H-271 Installation: 03-18-91 to 03-18-91 Boring TD = 65' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 65'	D. Geshwender (CH) D. Morrison (EB) C. Faus (BR) T. Childress (BR) R. Dependahl (BR)

WELL/BORING	EQUIPMENT	ON-SITE PERSONNEL
H-272 Installation: 03-20-91 to 03-20-91 Boring TD = 30' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 30'	G. Schaefer (CH) A. Grigsby (EB) R. Holder (BR) N. Risner (BR) G. Shetley (BR)
MW-202 Installation: 03-21-91 to 03-25-91 Development: 03-29-91 TO 04-01-91 Well TD = 85' bgs	CME 55; 7 3/4 OD Hollow Stem Auger 85'	E. Pomar (CH) D. Frain (EB) C. Faus (BR) R. Dependahl (BR) T. Childress (BR) M. Umfleet (BR)
H-266 Installation: 03-12-91 to 03-12-91 Well TD = 75' bgs	CME 55; 7 3/4 OD Hollow Stem Auger 75'	G. Schaefer (CH) C. Webb (CH) A. Grigsby (EB) G. Autry (BR) S. Umfleet (BR) C. Thompson (BR)
H-267 Installation: 03-13-91 to 03-15-91 Well TD = 75' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 75'	E. Pomar (CH) D. Frain (EB) R. Holder (BR) N. Risner (BR) G. Shetley (BR)
H-268 Installation: 03-14-91 to 03-14-91 Well TD = 90' bgs	CME 55; 7 3/4 OD Hollow Stem Auger 90'	G. Schaefer (CH) A. Grigsby (EB) G. Autry (BR) S. Umfleet (BR) C. Thompson (BR)
H-269	NOT DRILLED	
MW-203 Installation: 04-02-91 to 04-03-91 Development: 04-09-91 TO 04-17-91 Well TD = 80' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 80'	E. Pomar (CH) G. Autry (BR) S. Umfleet (BR) R. Dependahl (BR) G. Shetley (BR) D. Frain (EB)
MW-204 Installation: 04-05-91 to 04-05-91 Development: '04-09-91 TO 04-17-91 Well TD = 55' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 55'	G. Schaefer (CH) G. Autry (BR) G. Shetley (BR) S. Umfleet (BR) D. Frain (EB)

WELL/BORING	EQUIPMENT	ON-SITE PERSONNEL
MW-205 Installation: 05-03-91 to 05-06-91 Development: 05-09-91 TO 05-11-91 Well TD = 60' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 60'	D. Geshwender (CH) D. Morrison (EB) G Autry (BR) G. Shetley (BR) S. Umfleet (BR)
MW-206 Installation: 05-09-91 to 05-10-91 Development: 05-11-91 TO 05-14-91 Well TD = 45' bgs	CME 75; 7 3/4 OD Hollow Stem Auger 45'	G. Schaefer (CH) D. Morrison (EB) J. Lutman (BR) S. Umfleet (BR) R. Dependahl (BR)

(CH)= CH2M HILL
(EB)= TMA EBERLINE
(BR)= BROTCKE ENGINEERING
(TD)= TOTAL DEPTH
(bgs)= BELOW GROUND SURFACE

Attachment 5-B

SOIL BORING LOGS

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW191	SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Augden Landing Road & Little Bayou

ELEVATION 357.12 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/13/91 FINISH 3/14/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					0 to 50' not logged. See MW192 log for this information.		
50	50-55	5' Continuous	5.0	N/A	POORLY GRADED SAND (SP), grayish orange (10 YR 2/4), wet, sand grades from coarse to very coarse with 30% gravel		HNu = 0 ppm Rad = 26 cpm Gravel in catcher
55	55-60	5' Continuous	1.5	N/A	POORLY GRADED SAND (SP), same as above except greater percent of gravel		HNu = 0 ppm Rad = 25 cpm Gravel in catcher
60					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW192 SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Little Bayou Creek and Aogden Landing Rd.

ELEVATION 356.90 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/7/91 FINISH 3/8/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu =0 ppm; Rad =30 cpm
	0-5	5' Continuous	2.6	N/A	LEAN CLAY (CL), dark yellowish brown, moist		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 2.0 kg/cm^2
5	5-10	5' Continuous	4.0	N/A	Top1.5' : CLAYEY SAND (SC), medium gray (N5), sand fine grained, wet Bottom 2.5' : CLAYEY SAND (SC), same as above except pale yellowish brown (10 YR 6/8), and moist		HNu = 0 ppm Rad = 30 cpm P.P. = .5 kg/cm^2 (top) P.P. = 3.25 kg/cm^2 (bottom)
10	10-15	5' Continuous	5.0	N/A	CLAYEY SAND (SC), pale yellowish brown (10 YR 6/2), with mottling, trace gravel, moist, sand - medium to fine grained		HNu = 0 ppm Rad = 40 cpm P.P. = 2.5-4.5 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), moderate reddish brown (10 R 4/6), moist to slightly wet, some mottling		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5->4.5 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	LEAN CLAY (CL), light gray (N7), some mottling, moist		HNu = 0 ppm Rad = 28 cpm P.P. = 4.0 kg/cm^2
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY W/SAND (CL), pale yellowish brown (10 YR 6/2) with mottling, moist		HNu = 0 ppm Rad = 30 cpm P.P. = 2.0 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW192	SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Little Bayou Creek and Aogden Landing Rd.

ELEVATION 356. 90 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/7/91 FINISH 3/8/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	2.7	N/A	SANDY LEAN CLAY W/OCCASIONAL GRAVEL (CL), light gray (N7), moist (w/exception of top 6" which was wet) Bottom .4' : POORLY GRADED SAND (SP), light gray (N7), moist, medium grained		HNu = 0 ppm Rad = 40 cpm P.P. = 1.5 kg/cm^2 1' slough
35	35-40	5' Continuous	2.0	N/A	POORLY GRADED SAND (SP), same as above except wet and coarser grained		HNu = 0 ppm Rad = 34 cpm P.P. = N/A
40	40-45	5' Continuous	4.2	N/A	Top 2.7' : POORLY GRADED SAND (SP), same as above except slightly greater percent clay Middle .5' : WELL GRADED SAND W/GRAVEL (SW), medium gray (N7), wet Bottom 1.0' : SANDY LEAN CLAY (CL), medium gray (N5), moist, very stiff		HNu = 0 ppm Rad = 40 cpm P.P. = 2.5 kg/cm^2 (bottom 1')
45	45-50	5' Continuous	3.7	N/A	Top 3.2' : FAT CLAY (CH), medium gray (N5), moist, bottom 1.0' getting a greater percentage of sand Bottom .5' : CLAYEY SAND (SC), pale yellowish brown (10 YR 6/2), moist, sand - coarse gray		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5-3.5 kg/cm^2 (top)
50					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW193	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: Ogden Lndg. Road at Power Lines

ELEVATION: 366.24 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 4/26/91 09:03 FINISH: 4/26/91 12:23 LOGGER: C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					ORGANIC SOIL (OL/OH), dark yellowish brown (10 YR 4/2), moist, firm, crumbles, fine grained		Bkgd: HNu =0 ppm; Rad =21 cpm
	0-5	5' Continuous	4.5	N/A	LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and light gray (N7), moist, hard, crumbles LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4), light brown (5 YR 5/6), and light gray (N7), stiff to very stiff, moist, slightly plastic, oxidation and moisture in with depth		HNu = 0 ppm Rad = 52 cpm Pocket Pen (P.P.) = 1.0-74.5 kg/cm^2
5	5-10	5' Continuous	5.0	N/A			HNu = 0 ppm Rad = 44 cpm P.P. = 1.0-3.25+ kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, except with heavy oxidation 2'-2.5'		HNu = 0 ppm Rad = 65 cpm P.P. = 1.25-74.5 kg/cm2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, except with trace ferrous nodules LEAN CLAY W/SAND (CL), 3.5-4.5', trace gravel and ferrous nodules, same color, very stiff, moist LEAN CLAY (CL), mottled light brown (5 YR 5/6),mod. brown (5 YR 4/4) and light brown gray (5 YR 6/2), moist, stiff to very stiff, crumbles		HNu = 0 ppm Rad = 28 cpm P.P. = 2.5-3.75 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	WELL GRADED SAND W/CLAY (SW-SC), light brown (5 YR 5/6), moist, trace chert gravel, 4" below SANDY LEAN CLAY (CL), mottled light brown (5 YR 5/6), moderate yellowish brown (10 YR 5/4) and light brown gray (5 YR 6/1), moist, stiff, crumbles, trace chert gravel, some oxidation staining		HNu = 0 ppm Rad = 62 cpm P.P. = 2.0-3.0 kg/cm2
25	25-30	5' Continuous	5.0	N/A			HNu = 0 ppm Rad = 43 cpm P.P. = 1.25-1.75 kg/cm2
30							

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW193	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Ogden Lndg. Road at Power Lines

ELEVATION 366.24 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/26/91 09:03 FINISH 4/26/91 12:23 LOGGER C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), mottled pale yellowish brown (10 YR 6/2) and light brown (5 YR 5/6) and light brown gray (5 YR 6/1), moist, stiff to very stiff, crumbles CLAYEY SAND (SC), mottled pale yellowish brown, light brown, and medium gray, moist, trace gravel and oxidized streaking		HNu = 0 ppm Rad = 44 cpm P.P. = 1.0-3.25 kg/cm^2 09:40 Stopped drilling to decon samplers
35	35-40	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), mottled pale yellowish brown (10 YR 6/2) and light brown (5 YR 5/6) and light brownish gray (5 YR 6/1), wet from D.N. H_20, very stiff to hard LEAN CLAY W/SAND (CL), moderate brown (5 YR 4/4), moist, very stiff, trace subrounded chert gravel		10:49 Resumed drilling HNu = 0 ppm Rad = 40 cpm P.P. = 2.0->4.5 kg/cm^2
40	40-45	5' Continuous	4.5	N/A	LEAN CLAY W/ SAND (CL), same as above, except mottled with light brown oxidation streaking and trace nodules		HNu = 0 ppm Rad = 48 cpm P.P. = 2.25-4.0 kg/cm^2
45	45-50	5' Continuous	5.0	N/A	LEAN CLAY W/ SAND (CL), same as above, darker oxidation LEAN CLAY W/SAND (CL), mottled moderate brown (5 YR 4/4) and light gray (N7), light gray is plastic, moist, very stiff to hard		HNu = 0 ppm Rad = 36 cpm P.P. = 1.75->4.5 kg/cm^2
50	50-55	5' Continuous	5.0	N/A	POORLY GRADED SAND W/ CLAY (SP-SC), mottled moderate brown (5 YR 4/4), and light gray (N7), gray is plastic, top 2' wet, rest is moist, very stiff, micaceous fine sand.		HNu = 0 ppm Rad = 50 cpm P.P. = 2.0-2.5 kg/cm2 Driller reports water in hole
55	55-60	5' Continuous	3.0	N/A	POORLY GRADED SAND W/ CLAY (SP-SC), same as above, no gray POORLY GRADED SAND W/CLAY (SP-SC), micaceous, light gray (N7), wet, stiff		HNu = 0 ppm Rad = 42 cpm P.P. = 1.0-1.75 kg/cm2
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW193	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Ogden Lndg. Road at Power Lines

ELEVATION 366.24 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig: 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/26/91 09:03 FINISH 4/26/91 12:23 LOGGER C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	2.5	N/A	? ? ? ? ? WELL GRADED SAND W/GRAVEL (SW), micaceous sand, subrounded chert gravel, moderate yellowish brown (10 YR 5/4), wet, gravel content in cr. w/depth WELL GRADED GRAVEL (GW), wet, subrounded to subangular chert		HNu = 0 ppm Rad = 47 cpm P.P. = N/A
65	65-70	5' Continuous	2.5	N/A	WELL GRADED GRAVEL (GW), same as above		HNu = 0 ppm Rad = 35 cpm P.P. = N/A Sand heave on top 1' of recovered sample
70					End of Boring		Stopped drilling 11:45

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW194	SHEET 1 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Off Site, Next to Big Bayou Creek

ELEVATION 353.76 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/7/91 08:00 FINISH 3/8/91 13:15 LOGGER J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL DRILL PAD		Bkgd: OVA=0 ppm; Rad=40 cpm
	0-5	5' Continuous	3.5	N/A	LEAN CLAY (CL), dark yellow brown (10 YR 4/2), moist; organics and trace gravel present in top 2'		OVA = 0 ppm Rad = 50 cpm Pocket Pen (P.P.) = 0.4-1.7 kg/cm^2
5	5-10	5' Continuous	2.9	N/A			OVA = 0 ppm Rad = 35 cpm P.P. = 2.5-4.5+ kg/cm^2
					SILT W/SAND (ML), grayish orange (10 YR 7/4), moist		
10	10-15	5' Continuous	0.5	N/A	POORLY GRADED SAND (SP), moderate yellowbrown (10 YR5/4), wet ? —— ? —— ? —— ? —— ?		OVA = 0 ppm Rad = 35 cpm P.P. = N/A (gravel)
					WELL GRADED GRAVEL W/SAND (GW), moderate yellow brown (10 YR 5/4), wet; subrounded gravel		
15	15-20	5' Continuous	5.0	N/A	FAT CLAY (CH), dark yellow orange (10 YR 6/6), moist; grades leaner and mottles moderately red brown (10 R 4/6) past 19'		OVA = 0 ppm Rad = 60 cpm P.P. = 3.7-4.5+ kg/cm^2
20	20-25	5' Continuous	5.0	N/A	FAT CLAY (CH), moderate red brown (10 R 4/6), mottling light gray (N7), moist		OVA = 0 ppm Rad = 40 cpm P.P. = 3.2-3.5 kg/cm2
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6), mottling light gray (N7), moist		OVA = 0 ppm Rad = 30 cpm P.P. = 2.0-2.7 kg/cm2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW194 SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Off Site, Next to Big Bayou Creek

ELEVATION 353.76 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/7/91 08:00 FINISH 3/8/91 13:15 LOGGER J. Anderson

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	4.7	N/A	LEAN CLAY W/ SAND (CL), light brown (5 YR 5/6), mottled light gray (N7), moist; grades to SANDY LEAN CLAY (CL) past 33'		OVA = 0 ppm Rad = 40 cpm P.P. = 0.2-0.7 kg/cm^2
35	35-40	5' Continuous	3.2	N/A	POORLY GRADED SAND (SP), light brown (5 YR 5/6), wet, fine sand		OVA = 0 ppm Rad = 35 cpm P.P. = N/A (sand)
40	40-45	5' Continuous	4.1	N/A	POORLY GRADED SAND (SP), same as above, with CLAYEY SAND pockets from 42-43'		OVA = 0 ppm Rad = 50 cpm P.P. = N/A (sand)
45	45-50	5' Continuous	2.2	N/A	WELL GRADED GRAVEL W/SAND (GW), light brown (5 YR 5/6), wet		OVA = 0 ppm Rad = 35 cpm P.P. = N/A (gravel)
50	50-55	5' Continuous	2.0	N/A	WELL GRADED GRAVEL W/SAND (GW), same as above		OVA = 0 ppm Rad = 40 cpm P.P. = N/A (gravel)
55					End of Boring		
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW195 SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Off Site, Next to Big Bayou Creek

ELEVATION 354.03 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/12/91 FINISH 3/12/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					ORGANIC SOIL (OL/OH)		Bkgd: HNu=0 ppm; Rad =__ cpm
	0-5	5' Continuous	2.0	N/A	Next 10" - LEAN CLAY (CL), dark yellowish brown (10 YR 4/2), moist		HNu = 0 ppm Rad = 34 cpm Pocket Pen (P.P.) = 1.25-2.5 kg/cm^2
5	5-10	5' Continuous	4.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 32 cpm P.P. = .25 kg/cm^2
					SILT W/SAND (ML), gray orange (10 YR 1/4), moist		
10	10-15	5' Continuous	3.5	N/A	Top 14" : WELL GRADED GRAVEL W/SAND (GW), wet Next 9" : POORLY GRADED SAND (SP), wet 1' : FAT CLAY (CH), dark yellow orange with light gray 13' : Mottled red brown (10 YR 4/6)		HNu = 0 ppm Rad = 39 cpm P.P. = 2.5-3.0 kg/cm^2 Installed well at 11'
15	15-20	5' Continuous	4.5	N/A	FAT CLAY (CH), same as above		OVA = 0 ppm Rad = 41 cpm P.P. = 30 kg/cm^2
20					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW196	SHEET 1 OF 1

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION South of Plant on Hobbs Road

ELEVATION 387.47 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/18/91 FINISH 3/18/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=30 cpm
	0-5	5' Continuous	2.4	N/A	LEAN CLAY (CL), dusky brown (5 YR 2/2), moist, firm, small percent of gravel in top 1.5'		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 1.0 kg/cm^2
5	5-10	5' Continuous	2.5	N/A	LEAN CLAY (CL), same as above except for light brown (5 YR 5/6), streaking		HNu = 0 ppm Rad = 35 cpm P.P. = 1.25 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except for medium light gray (N6), streaks		HNu = 0 ppm Rad = 40 cpm P.P. = 1.25 kg/cm^2
15	15-20	5' Continuous	4.4	N/A	3.9' : LEAN CLAY (CL), same as above except stiff 0.5' : WELL GRADED SAND W/GRAVEL (SW), moderate brown (5 YR 3/4), wet, medium to fine grained sand, rounded chert		HNu = 0 ppm Rad = 40 cpm P.P. = 1.75 kg/cm^2 for CL
20	20-25	5' Continuous	1.4	N/A	WELL GRADED GRAVEL W/SAND (GW), moderate brown (5 YR 3/4), wet, rounded chert, medium to fine grained sand		HNu = 0 ppm Rad = 35 cpm P.P. = N/A Sampler wet out of hole
25	25-30	5' Continuous	4.7	N/A	LEAN CLAY (CL), grayish black (N2), moist, hard in vertical direction and fractures (blocky) in horizontal direction, some lamination of silt and sand, fissured End of Boring		HNu = 0 ppm Rad = 30 cpm P.P. = 4.25 kg/cm^2 (vertic P.P. approx. 0.25 kg/cm^2 (horiz.)
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW197	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: M6 Road North of Plant

ELEVATION: 366.54 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 3/19/91 FINISH: 3/21/91 LOGGER: D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=30 cpm
	0-5	5' Continuous	3.1	N/A	LEAN CLAY (CL), medium gray (N5), moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 2.5 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), medium dark gray (N4) with mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 3.0 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except medium gray (N5) to pale yellowish brown (10 YR 4/6)		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm2
15	15-20	5' Continuous	3.5	N/A	Top 2.5' : SANDY LEAN CLAY (CL), medium gray (N5), moist, very stiff, sand - fine grained Bot. 1.0' : CLAYEY SAND (SC), moderate reddish orange (10 R 6/6), moist, firm, sand - medium grained		HNu = 0 ppm Rad = 30 cpm P.P. = 3.5 kg/cm^2 (top) P.P. = 1.0 kg/cm^2 (bottom)
20	20-25	5' Continuous	5.0	N/A	Top 1.0' : CLAYEY SAND (SC), same as above Bot. 4.0' : LEAN CLAY (CL), pale yellowish brown (10 YR 4/6), moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = .25 kg/cm^2 (top) P.P. = 4.0 kg/cm^2 (bottom)
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW197 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION M6 Road North of Plant

ELEVATION 366.54 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	LEAN CLAY (CL) with trace sand, medium gray (N5) with mottling, moist, very stiff, sand is fine grained		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
35	35-40	5' Continuous	5.0	N/A	Top 2.0' : LEAN CLAY (CL), same as above Bot. 3.0' : LEAN CLAY (CL), yellowish brown with mottling, moist, hard, with large (.15') gravel		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2 (top) P.P. = >4.5 kg/cm^2 (bottom)
40	40-45	5' Continuous	3.5	N/A	LEAN CLAY (CL), moderate reddish brown (10 R 4/6), with mottling, moist, hard		HNu = 0 ppm Rad = 30 cpm P.P. = >4.5 kg/cm2
45	45-50	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate reddish brown (10 R 4/6) with mottling, moist, very stiff, with fine sand and mica flakes		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2
50	50-55	5' Continuous	2.8	N/A	Top 1.3' : LEAN CLAY (CL), same as above Bot. 1.5' : POORLY GRADED SAND (SP), moderate reddish brown (10 R 4/6), wet, sand is medium to coarse grained		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
55	55-60	5' Continuous	1.4	N/A	WELL GRADED SAND W/GRAVEL (SW), wet, sand is fine to coarse grained, gravel is subangular to angular		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW197	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION M6 Road North of Plant

ELEVATION 366.54 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	0.0	N/A	No Recovery		
65				N/A	End of Boring		

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW199 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of Ogden Landing Road

ELEVATION 353.87 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/8/91 FINISH 5/8/91 LOGGER G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL PAD (= 0.3')		Bkgd: HNu=0 ppm; Rad=30 cpm
	0-5	5' Continuous	1.3	N/A	LEAN CLAY (CL), light brown (5 YR 6/4) with light gray (N7), mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 4.0 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), grayish orange pink (5 YR 7/2) with light gray (N7), mottling and black (N1) streaking, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 3.75 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm2
15	15-20	5' Continuous	5.0	N/A	2.6' : LEAN CLAY (CL), same as above 1.5' : WELL SORTED SAND (SW), moderate red (5 R 5/4), moist 0.9' : LEAN CLAY W/SAND (CL), light brown (5 YR 6/4), moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 for CL
20	20-25	5' Continuous	5.0	N/A	1.9' : LEAN CLAY W/SAND (CL), same as above 3.1' : LEAN CLAY (CL), light brown (5 YR 6/4), moist, very stiff, light gray (N7) mottling		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2 for lower CL
25	25-30	5' Continuous	4.3	N/A	LEAN CLAY (CL), same as above except stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW199	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of Ogden Landing Road
ELEVATION 353.87 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.
DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler
WATER LEVEL AND DATE N/A START 5/8/91 FINISH 5/8/91 LOGGER G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	3.5	N/A	1.0' : LEAN CLAY (CL), moderate brown (5 YR 4/4), moist, very stiff 2.5' : LEAN CLAY (CL), light brown (5 YR 6/4) with moderate red (5 R 4/6) and light gray (N7) mottling, moist hard		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 (top) P.P. = >4.5 kg/cm^2 (bottom)
35	35-40	5' Continuous	4.3	N/A	LEAN CLAY (CL), same as above. Small percent of gravel at bottom 0.4'; well rounded chert		HNu = 0 ppm Rad = 30 cpm P.P. = >4.5 kg/cm^2
40	40-45	5' Continuous	1.7	N/A	WELL SORTED SAND W/GRAVEL (SW), light brown (5 YR 5/6) with moderate red (5 R 4/6) mottling, moist, subangular gravel, medium to coarse grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
45	45-50	5' Continuous	3.9	N/A	WELL SORTED SAND (SW), moderate red (5 R 5/4), wet, medium to fine grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
50	50-55	5' Continuous	4.7	N/A	Top 3' : WELL SORTED SAND (SW), same as above WELL GRADED GRAVEL (GW), medium brown (5 YR 4/4), wet, well rounded chert gravel		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
55	55-60	5' Continuous	1.4	N/A	WELL GRADED GRAVEL (GW), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW199	SHEET 3 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: North of Ogden Landing Road

ELEVATION: 353.87 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 5/8/91 FINISH: 5/8/91 LOGGER: G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	0.0	N/A	No Recovery		HNu = 0 ppm Rad = 30 cpm P.P. = N/A No recovery due to large gravel
65					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	MW200 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road

ELEVATION 377.11 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/20/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL PAD -		Bkgd: HNu=0 ppm; Rad=23 cpm
	0-5	5' Continuous	5.0	N/A	TOPSOIL 9" LEAN CLAY (CL), light olive gray (5 YR 6/1) with some dark yellowish orange (10 YR 6/6)		HNu = 0 ppm Rad = 32 cpm Pocket Pen (P.P.) = 1.0-2.75 kg/cm^2
5	5-10	5' Continuous	4.2	N/A	LEAN CLAY (CL), same as above with organic material present on bottom 2'		HNu = 0 ppm Rad = 40 cpm P.P. = 1.0-3.5 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above bottom 2'		HNu = 0 ppm Rad = 38 cpm P.P. = 2.0-3.25 kg/cm2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, bottom 2' 3" contain some silt		HNu = 0 ppm Rad = 57 cpm P.P. = 2.5-4.0 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 54 cpm P.P. = 3.75-4.5 kg/cm^2
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above Isolation casing set 30'		HNu = 0 ppm Rad = 36 cpm P.P. = 2.25-3.5 kg/cm2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW200	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road

ELEVATION 377.11 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/20/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	3.6	N/A	Top 1.8' : LEAN CLAY (CL), light olive gray (5 GY 6/1) with some dark yellowish orange (10 YR 6/6) SANDY LEAN CLAY (CL), grayish orange (10 YR 7/4) with light olive gray on bottom 1.7'		HNu = 0 ppm Rad = 40 cpm Pocket Pen (P.P.) = 3.25-4.5 kg/cm^2 Resumed drilling 3/20/91
35	35-40	5' Continuous	3.8	N/A	SANDY LEAN CLAY (CL), same as above for top 2.2' WELL GRADED SAND W/CLAY (SC), light brown (5 YR 5/6), moist for bottom 1.4', last 2" LEAN CLAY (CL)		HNu = 0 ppm Rad = 35 cpm P.P. = 1.0-1.25 kg/cm^2
40	40-45	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), light olive gray (5 GY 6/1) with dark yellowish orange (10 YR 6/6)		HNu = 0 ppm Rad = 40 cpm P.P. = 1.0-2.25 kg/cm2
45	45-50	5' Continuous	4.9	N/A	SANDY LEAN CLAY (CL), same as above for top 3.2', some dark spots WELL GRADED SAND W/CLAY (SC), light brown (5 YR 5/6), moist		HNu = 0 ppm Rad = 30 cpm P.P. = 1.5-2.0 kg/cm^2
50	50-55	5' Continuous	5.1	N/A	Top 4" : WELL GRADED SAND W/ GRAVEL (SC), same as above, Next 3" : LEAN CLAY (CL), light brown (5 YR 5/6) w/organic material, FAT CLAY (CH), fat medium light gray (N6) for 1.6' LEAN CLAY (CL), light olive gray w/light brown (5 YR 5/6) some pebbles as large as 1" found randomly and sparsely on this bottom 2.9'		HNu = 0 ppm Rad = 50 cpm P.P. = 2.25-4.25 kg/cm^2
55	55-60	5' Continuous	5.0	N/A	Top 4' : LEAN CLAY (CL), same as above, but no pebbles Bot. 1' : LEAN CLAY (CL), light brown (5 YR 5/6) with presence of hard organic material		HNu = 0 ppm Rad = 35 cpm P.P. = 1.25-2.0 kg/cm2
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW200	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road

ELEVATION 377.11 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig: 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/20/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, light brown (5 YR 5/6) with presence of organic material, top 2.9' LEAN CLAY (CL), light gray (N7) with light brown (5 YR 6/6) with presence of dark hard organic spots, for bottom 3.1'		HNu = 0 ppm Rad = 59 cpm P.P. = 2.5-3.75 kg/cm^2
65	65-70	5' Continuous	3.1	N/A	Top 1.9' : LEAN CLAY (CL), same as above Bot. 1.2' : WELL GRADED GRAVEL W/SAND (GW), with pieces as large as 2.5"		HNu = 0 ppm Rad = 52 cpm P.P. = 2.75 kg/cm^2
70	70-75	5' Continuous	1.7	N/A	Top 6" : WELL GRADED GRAVEL (GW), same as above 4" layer presence of some LEAN CLAY (CL), light gray (N8) with gravel WELL GRADED GRAVEL W/SAND (GW), for bottom 10"		HNu = 0 ppm Rad = 24 cpm P.P. = N/A
75	75-80	5' Continuous	1.9		WELL GRADED GRAVEL W/SAND (GW), same as above		HNu = 0 ppm Rad = 20 cpm P.P. = N/A Well installed at 80'
80					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.FS	MW203	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of the C-720 building

ELEVATION 374.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/2/91 FINISH 4/3/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Backfill from concrete pad		Bkgd: HNu=0 ppm Rad=77 cpm
	0-5	5' continuous	4.9	N/A	1.8' ORGANIC SOIL (OL/OH) Bottom 4" LEAN CLAY (CL), light gray (N7) with dark yellowish orange (10 YR 6/6) mottling, moist		HNu = 0 ppm Rad = 74 cpm Pocket Pen (P.P.) = N/A
5	5-10	5' continuous	0.5	N/A	LEAN CLAY (CL), same as above Top 3.1' - LEAN CLAY (CL), same as above, but light brownish grey (5 YR 6/1), CLAYEY SAND (SC) seam, light olive gray (5 Y 6/1), with moderate yellow brown (10 YR 5/4), mottling, moist		HNu = 0 ppm Rad = N/A P.P. = N/A
10	10-15	5' continuous	5.0	N/A			HNu = 0 ppm Rad = 50 cpm P.P. = 3.5 kg/cm^2
15	15-20	5' continuous	5.0	N/A	2.5' - LEAN CLAY (CL), light olive gray (5 Y 6/1) with dark yellowish orange (10 YR 6/6) mottling, moist 1.5' - SANDY LEAN CLAY (CL), light olive gray (5 Y 6/1) .8' - seam of POORLY GRADED SAND W/ CLAY (SP), light olive gray (5 Y 6/1) with light brown (5 YR 5/6)		HNu = 0 ppm Rad = 46 cpm P.P. = 3.5 kg/cm^2
20	20-25	5' continuous	4.2	N/A	.5' - SANDY LEAN CLAY (CL), light olive gray (5 Y 6/1), moist 1.7' - WELL GRADED SAND W/ GRAVEL, subangular ????? pieces .4' - SANDY LEAN CLAY (CL),light olive gray (5 Y 6/1) with light brown (5 YR 5/6) mottling, some dark organic matter .9' - CLAYEY SAND (SC), grayish orange (10 YR 7/4) with angular gravel .4' - SANDY LEAN CLAY (CL), light gray (N7) .9' - POORLY GRADED SAND W/ CLAY AND GRAVEL (SP/SC), grayish orange (10 YR 7/4), w/ light brown (5 YR 5/6) some angular & large subrounded pieces, dry		HNu = 0 ppm Rad = 39 cpm P.P. = 1.5-2.25 kg/cm^2
25							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	MW203	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of the C-720 building

ELEVATION 374.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/2/91 FINISH 4/3/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
25							Bkgd: HNu=0 ppm; Rad=87 cpm
	25-30	5' continuous	1.5	N/A	POORLY GRADED SAND W/ CLAY AND GRAVEL (SP-SC), grayish orange (10 YR 7/4) with light brown (5 YR 5/6) angular and subrounded gravel. Dry bottom 17' moist		HNu = 0 ppm Rad = 52 cpm P.P. = N/A Resumed drilling 4/03/91
30	30-35	5' continuous	2.3	N/A	Top .3': POORLY GRADED SAND W/ GRAVEL (SP-SC), same as above 1.2' : POORLY GRADED SAND (SP-SC), yellowish gray (5 YR 8/1), moist .2' : POORLY GRADED SAND W/ CLAY & GRAVEL (SP-SC), moist Bottom .8' : SANDY LEAN CLAY W/ GRAVEL, grayish orange (10 YR 7/4),mottling w/ dark yellow orange (10 YR 6/6), moist		HNu = 0 ppm Rad = 47 cpm P.P. = 1.5 kg/cm^2
35	35-40	5' continuous	3.5	N/A	Top 1.2' : POORLY GRADED SAND (SP-SC) yellowish gray (5 Y 8/1) with dark yellowish orange (10 YR 6/6) mottling, moist .3' : POORLY GRADED SAND (SP), same as above, with small gravel Bottom 2' : LEAN CLAY (CL), yellowish gray (5 Y 8/1) with dark yellowish orange (10 YR 6/6), very moist		HNu = 0 ppm Rad = 44 cpm P.P. = .75 kg/cm^2
40	40-45	5' continuous	5.0	N/A	SANDY LEAN CLAY (CL), same as above, only moist		HNu = 0 ppm Rad = 34 cpm P.P. = 2.25-2.75 kg/cm^2
45	45-50	5' continuous	5.0	N/A	4.2' : SANDY LEAN CLAY (CL), same as above, with some grayish orange pink (5 YR 5/2) and light brown (5 YR 6/4) mottling .8' : POORLY GRADED SAND (SP), grayish orange (10 YR 7/4), moist		HNu = 0 ppm Rad = 43 cpm P.P. = .5-2.75 kg/cm^2
50	50-55	5' continuous	1.5	N/A	POORLY GRADED SAND (SP), same as above with gravel, very moist		HNu = 0 ppm Rad = 26 cpm P.P. = N/A
55							

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.BI	MW203 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of the C-720 building

ELEVATION 374.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/2/91 FINISH 4/3/91 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
55	55-60	5' continuous	3.6	N/A	Top 1.3' : POORLY GRADED SAND W/ CLAY (SP-SC), grayish orange (10 YR 7/4) with gravel, wet SANDY LEAN CLAY (CL), grayish orange (10 YR 7/4), moist		HNu = 0 ppm Rad = 56 cpm P.P. = 2.5-3.25 kg/cm^2
60	60-65	5' continuous	0.4	N/A	Top 1.8': SANDY LEAN CLAY (CL), same as above but yellowish gray (5 Y 8/1) 1.2 : CLAYEY SAND (SC), dark yellowish orange (10 YR 6/6), moist 1.3' : POORLY GRADED SAND (SP), dark yellowish orange (10 YR 6/6), wet		HNu = 0 ppm Rad = 52 cpm P.P. = 1.0-2.25 kg/cm^2
65	65-70	5' continuous	3.1	N/A	POORLY GRADED SAND (SP), mottled with grayish orange (10 YR 7/4)		HNu = 0 ppm Rad = 46 cpm P.P. = N/A Driller reports gravel at + or - 67.5' samples Driller reports large gravel in shoe
70	70-75	5' continuous	1.8	N/A	Top .8': POORLY GRADED SAND (SP), same as above Bottom 1': WELL GRADED GRAVEL W/ SAND (GW), subangular pieces, wet		HNu = 0 ppm Rad = 28 cpm P.P. = N/A Drill rig started to shake
80	75-80	5' Continuous	2.9	N/A	>8' : Sand Heave 1.5' : POORLY GRADED SAND (SP), dark yellowish orange (10 YR 6/6) .6' : WELL GRADED GRAVEL W/ SAND (GW0, water in sampler		HNu = 0 ppm Rad = 27 cpm P.P. = N/A
85					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.BI	MW205 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East of C335

ELEVATION 377.22 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/3/91 FINISH 5/6/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0-5	5' Continuous	5.0	N/A	LEAN CLAY (CL), pale yellowish brown (10 YR 6/2) with mottling, moist, hard, top 1' contains some gravel		HNu = 0 ppm Rad = 35 cpm Pocket Pen (P.P.) = 4.0->4.5 kg/cm^2
5	5-10	5' Continuous	3.2	N/A	LEAN CLAY (CL), light brown (5 YR 5/6), moist, some mottling, stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 1.5-2.0 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 35 cpm P.P. = 2.5 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), with some sand in upper 1', moderate brown (5 YR 4/4) with mottling, moist, hard, sand-fine		HNu = 0 ppm Rad = 35 cpm P.P. = 4.0 kg/cm^2
20	20-25	5' Continuous	2.0	N/A	Top 1.3'- LEAN CLAY (CL), same as above Bottom .7' - WELL GRADED SAND (SW), light brown (5 YR 5/6), moist		HNu = 0 ppm Rad = 35 cpm P.P. = 3.5 kg/cm^2 -Top
25	25-30	5' Continuous	1.9	N/A	POORLY GRADED SAND (SP), light brown (5 YR 5/6), moist, sand-medium grained		HNu = 0 ppm Rad = 35 cpm P.P. = N/A kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	MW205	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East of C335

ELEVATION 377.22 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/3/91 FINISH 5/6/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	3.4	N/A	SANDY LEAN CLAY (CL), with trace gravel, light brown (5 YR 6/4), with mottling, moist, stiff to very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 1.5-2.5 kg/cm^2
35	35-40	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate yellowish brown (10 YR 5/4), moist, with trace organics, very stiff, very hard		HNu = 0 ppm Rad = 35 cpm P.P. = 3.0->4.5 kg/cm^2
40	40-45	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except with mottling		HNu = 0 ppm Rad = 35 cpm P.P. = 4.0->4.5 kg/cm^2
45	45-50	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 35 cpm P.P. = >4.5 kg/cm^2
50	50-55	5' Continuous	3.3	N/A	Top 2.1' : LEAN CLAY (CL), same as above Bottom 1.2' : CLAYEY SAND (SC), moderate reddish brown (10 R 4/6), wet, sand-medium grained		HNu = 0 ppm Rad = 35 cpm P.P. = 4.0 kg/cm^2 - Top N/A - Bottom
55	55-60	5' Continuous	0.0	N/A	No Recovery		No Recovery
60							

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	MW205	SHEET 3 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: East of C335

ELEVATION: 377.22 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 5/3/91 FINISH: 5/6/91 LOGGER: D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	2.5	N/A	SILTY SAND (SM), light brown (5 YR 5/6), wet Bottom 0.5' - SILTY SAND W/ GRAVEL (SM), light brown (5 YR 5/6), wet		HNu = 0 ppm Rad = 35 cpm
65	65-70	5' Continuous	1.5	N/A	SILTY GRAVEL W/ SAND (GM), light brown (5 YR 5/6),wet		HNu = 0 ppm Rad = 35 cpm
70					End of Boring		

PROJECT NUMBER	BORING NUMBER
ORO30888.BI	MW206 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION South of C-631 Building

ELEVATION 382.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/9/91 FINISH 5/10/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=30 cpm
	0-5	5' Continuous	4.1	N/A	LEAN CLAY (CL), light brown (5 YR 6/4) with moderate brown (5 YR 4/4) streaking, moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 2.75 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4) with light gray (N7) mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.25 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 2.25 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 2.50 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except for small % of fine grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = 3.0 kg/cm^2
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 6/4) with light gray (N7) mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	MW206	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION South of C-631 Building

ELEVATION 382.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/9/91 FINISH 5/10/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	1.6	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4) with light gray (N7) streaking, moist, stiff, some small chert gravel		HNu = 0 ppm Rad = 30 cpm P.P. = 1.5 kg/cm^2
35	35-40	5' Continuous	4.7	N/A	LEAN CLAY (CL), same as above for top 3.1' WELL GRADED SAND (SW), moderate brown (5 YR 4/40) moist, medium to fine grained sands		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm^2
40	40-45	5' Continuous	1.8	N/A	1.2' : WELL GRADED SAND (SW), same as above except wet 0.6' : LEAN CLAY (CL), moderate brown (5 YR 4/4) with light gray (N7) streaking, moist, very stiff, some fine grained sands		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 for CL Setting Isolation Casing @ 45' bgs in CL
45	45-50	5' Continuous	4.0	N/A	2' : LEAN CLAY (CL), same as above 2' : WELL GRADED SAND (SW), moderate brown (5 YR 4/4) with light gray (N7) mottling, moist, fine to medium grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 for CL
50	50-55	5' Continuous	5.0	N/A	2' : WELL GRADED SAND (SW), same as above 2' : LEAN CLAY (CL), light gray (N7), moist, stiff 1' : WELL GRADED SAND (SW), moderate brown (5 YR 4/4) with light gray (N7) mottling, moist		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm^2 for CL
55	55-60	5' Continuous	5.0	N/A	4.5' : WELL GRADED SAND (SW), same as above 0.5' : LEAN CLAY (CL), light gray (N7), moist, stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm^2 for CL
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	MW206	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION South of C-631 Building

ELEVATION 382.95 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/9/91 FINISH 5/10/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	3.8	N/A	1.1' - LEAN CLAY (CL), light gray (N7), moist, stiff 2.7' - WELL GRADED SAND (SW), very light gray (N8), wet, fine to medium grained sands		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm^2
65	65-70	5' Continuous	5.0	N/A	WELL GRADED SANDS (SW), very light gray (N8) to light brown (5 YR 6/4), wet, fine to coarse grained sands		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
70	70-75	5' Continuous	1.5	N/A	WELL GRADED GRAVEL W/ SAND (GW), moderate brown (5 YR 4/4), wet, well rounded chert gravel, medium to coarse grained sands		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
75	75-80	5' Continuous	1.0	N/A	WELL GRADED GRAVEL W/ SAND (GW), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole Setting screen @ 80' bgs
80					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H266	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North End of M-4 Road

ELEVATION 366.08 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/12/91 FINISH 3/12/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=40 cpm
	0-5	5' Continuous	0.3	N/A	GRAVEL FILL MATERIAL, angular limestone		HNu = 0 ppm Rad = 40 cpm Pocket Pen (P.P.) = N/A
5	5-10	5' Continuous	2.9	N/A	LEAN CLAY (CL), moderate brown (5 YR 2/4), moist, soft		HNu = 0 ppm Rad = 45 cpm P.P. = 0.5 kg/cm^2
10	10-15	5' Continuous	4.9	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 50 cpm P.P. = 0.5 kg/cm^2
15	15-20	5' Continuous	4.8	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4) with medium light grey (N6) streaking, moist, very stiff		HNu = 0 ppm Rad = 45 cpm P.P. = 2.5 kg/cm^2
20	20-25	5' Continuous	4.9	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 45 cpm P.P. = 2.5 kg/cm^2
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except for moderate red streaking (5 R 5/4)		HNu = 0 ppm Rad = 40 cpm P.P. = 2.5 kg/cm^2
30							

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North End of M-4 Road

ELEVATION 366.08 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/12/91 FINISH 3/12/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 4/4) with light grey streaking (N7), moist, very stiff		HNu = 0 ppm Rad = 50 cpm P.P. = 4.0 kg/cm^2
35	30-35	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 50 cpm P.P. = 4.0 kg/cm^2
40	40-45	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except for soft		HNu = 0 ppm Rad = 40 cpm P.P. = 0.5 kg/cm^2
45	45-50	5' Continuous	4.0	N/A	SANDY LEAN CLAY (CL), moderate brown (5 YR 4/4) to moderate red (5 R 4/6), wet, stiff		HNu = 0 ppm Rad = 50 cpm P.P. = 1.0 kg/cm^2 Sampler wet out of hole
50	50-55	5' Continuous	3.7	N/A	Top 0.4': WELL GRADED SAND (SW), moderate red (5 YR 4/4) with black gravel, wet Bottom: SANDY LEAN CLAY (CL), moderate brown (5 YR 4/4), wet, very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 1.25 kg/cm^2 for CL Sampler wet
55	55-60	5' Continuous	3.8	N/A	Top 0.8': SANDY LEAN CLAY (CL), same as above Bottom 3': WELL GRADED SAND (SW), moderate brown (5 YR 4/4), wet, loose, medium to fine sands		HNu = 0 ppm Rad = 55 cpm P.P. = 1.25 kg/cm^2
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H266	SHEET 3 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation — LOCATION: North End of M-4 Road

ELEVATION: 366.08 NGVD — DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A — START: 3/12/91 — FINISH: 3/12/91 — LOGGER: G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-65	5' Continuous	3.5	N/A	2.3': LEAN CLAY (CL), moderate brown (5 YR 3/4), wet, very stiff 1.2': WELL GRADED SAND (SW), moderate red (5 YR 4/4), wet, loose, medium grained sand		HNu = 0 ppm Rad = 45 cpm P.P. = 2.5 kg/cm^2
65	65-70	5' Continuous	3.3	N/A	2.0': LEAN CLAY (CL), medium light grey (N6), moist,very stiff 1.3': WELL GRADED GRAVEL WITH SAND (GW), moderate brown (5 YR 3/4), wet, well rounded gravel, coarse grained sand		HNu = 0 ppm Rad = 40 cpm P.P. = 2.0 kg/cm^2
70	70-75	5' Continuous	2.9	N/A	WELL GRADED GRAVEL WITH SAND (GW), same as above		HNu = 0 ppm Rad = 40 cpm P.P. = N/A
75					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H267	SHEET 1 OF 4

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: North End of M-7 Road

ELEVATION: 370.53 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 3/13/91 8:58 FINISH: 3/15/91 12:45 LOGGER: E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL PAD and organic SOIL (OL/OH)		Bkgd: HNu= 0 ppm; Rad = 32 cpm
	0-5	5' Continuous	3.5	N/A	LEAN CLAY (CL), greenish gray (5 GY 6/1) with dark yellowish orange (10 YR 6/6) with dark organic (10 YR 8/6) top 1.4: LEAN CLAY (CL) light olive gray (5 Y 6/1) with pale yellow orange		HNu = 0 ppm Rad = 46 cpm P.P. = 1.75-3.75 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above. presence of dark organic spots, moist		HNu = 0 ppm Rad = 50 cpm P.P. = .5-2.75 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75-4.0 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	Top 2' : LEAN CLAY (CL), same as above Next 1' : LEAN CLAY (CL), yellowish grey (5 Y 8/1) with no organics Next 2' : LEAN CLAY WITH SAND (CL) yellow grey (5 Y 8/1) with dark yellow orange (10 YR 6/6), moist		HNu = 0 ppm Rad = 43 cpm P.P. = 2.75-4.75 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	5.2' : LEAN CLAY (CL), same as above 1.32' : SANDY LEAN CLAY (CL) dark yellow orange (10 YR 6/6), moist		HNu = 0.5 ppm Rad = 30 cpm P.P. = 1.25-2.75 kg/cm^2
25	25-30	5' Continuous	5.0	N/A	3.65' : SANDY LEAN CLAY (CL), same as above 1.32' : SANDY LEAN CLAY (CL), dark yellowish orange (10 YR 6/6) with some light brown (5 YR 5/6), with very fine WELL GRADED GRAVEL WITH CLAY AND SAND		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5->4.5 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
SED 30888.BI	H267	SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North End of M-7 Road

ELEVATION 370.53 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/13/91 8:58 FINISH 3/15/91 12:45 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	Top 2.5' : SANDY LEAN CLAY (CL), same as above 1.5" : SANDY LEAN CLAY (CL), yellowish gray (5 Y 8/1) with medium light gray (N6) and light brown (5 YR 5/6) Bottom 6" : SANDY LEAN CLAY (CL), dark yellowish orange (10 YR 6/6)		HNu = 0 ppm Rad = 39 cpm P.P. = 1.0-3.25 kg/cm^2
35	35-40	5' Continuous	5.0	N/A	Top 2' : SANDY LEAN CLAY (CL), same as above SANDY LEAN CLAY (CL), yellowish gray (5 Y 8/1)		HNu = 0 ppm Rad = 40 cpm P.P. = 2.5->4.5 + kg/cm^2
40	40-45	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), same as above but very light gray (N8) with very crumbly SANDY LEAN CLAY (CL), light brown (5 YR 5/6) with presence of some hard iron oxides		HNu = 0 ppm Rad = 30 cpm P.P. = 3.25->4.5 + kg/cm^2
45	45-50	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), same as above with higher content of iron oxides		HNu = 0 ppm Rad = 40 cpm P.P. = 0.5-3.75 kg/cm^2
50	50-55	5' Continuous	2.0	N/A	Poor Recovery Top 1' : SAND POORLY GRADED (SP), dark yellowish brown (10 YR 4/2) Bottom 1' : SILTY SAND (SM), dark yellowish orange (10 YR 6/6) with dark spots		HNu = 0 ppm Rad = 32 cpm P.P. = N/A
55	55-60	5' Continuous	1.5	N/A	SILTY SAND (SM), dark yellow orange (10 YR 6/6) with no dark organic spots, very wet		HNu = 0 ppm Rad = 40 cpm P.P. = N/A
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H267	SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North End of M-7 Road

ELEVATION 370.53 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig: 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/13/91 8:58 FINISH 3/15/91 12:45 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	5.0	N/A	SILTY SAND (SM), dark yellow orange (10 YR 6/6) with no dark organic spots		HNu = 0 ppm Rad = 44 cpm P.P. = N/A
65	65-70	5' Continuous	3.0	N/A	SILTY SAND (SM), same as above		HNu = 0 ppm Rad = 28 cpm P.P. = N/A
70	70-75	5' Continuous	2.0	N/A	2' : SILTY SAND (SM), same as above 6" : GRAVEL WELL GRADED WITH SAND (CW), moderate yellowish brown (10 YR 5/4), some angular large (+ or - 1.5") pieces		HNu = 0 ppm Rad = 28 cpm P.P. = N/A
75	75-80	5' Continuous	1.0	N/A	2' : SILTY SAND (SM), same as above 6" : GRAVEL WELL GRADED WITH SAND (CW), moderate yellowish brown (10 YR 5/4), some angular large (+ or - 1.5") pieces		HNu = 0 ppm Rad = 28 cpm P.P. = N/A
80	80-85	5' Continuous	0.0	N/A	No recovery		HNu = N/A Rad = N/A P.P. = N/A
85	85-90	5' Continuous	0.6	N/A	WELL GRADED GRAVEL WITH SAND (GW), moderate yellowish brown (10 YR 5/4), approximately 2' of heave present		HNu = 0 ppm Rad = 32 cpm P.P. = N/A
90							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H267	SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North End of M-7 Road

ELEVATION 370.53 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/13/91 8:58 FINISH 3/15/91 12:45 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90-95	5' Continuous	0.0	N/A	No recovery		Sampler lost from drill rods
95	95-100		0.0	N/A	No further sampling-attempting sampler recovery		
100	100-105		0.0	N/A			Sampler recovered by overboring
105					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H268	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION West End of Jim Allen Road

ELEVATION 367.37 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/14/91 FINISH 3/14/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=35 cpm
	0-5	5' Continuous	3.5	N/A	LEAN CLAY (CL), pale brown (5 YR 5/2), moist, very stiff, grayish brown (5 YR 3/2) top 0.5'		HNu = 0 ppm Rad = 35 cpm Pocket Pen (P.P.) = 2.0 kg/cm^2
5	5-10	5' Continuous	3.8	N/A	LEAN CLAY (CL), grayish orange (10 YR 7/4), dry, hard, fairly brittle, small % of silt intermixed with clay		HNu = 0 ppm Rad = 35 cpm P.P. = 4.5 kg/cm^2
10	10-12	5' Continuous	4.7	N/A	LEAN CLAY (CL), grayish orange (10 YR 7/4) with very light gray (N8) streaking, dry, hard, some interlayering of black (N1) CLAY, small % of SILT WITH CLAY		HNu = 0 ppm Rad = 40 cpm P.P. = >4.5 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 50 cpm P.P. = >4.5 kg/cm^2
20	20-25	5' Continuous	4.9	N/A	LEAN CLAY (CL), same as above except moist		HNu = 0 ppm Rad = 35 cpm P.P. = >4.5 kg/cm^2
25	25-30	5' Continuous	4.9	N/A	LEAN CLAY (CL), same as above except for very light grey (N8) mottling		HNu = 0 ppm Rad = 40 cpm P.P. = >4.5 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H268	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION West End of Jim Allen Road

ELEVATION 367.37 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/14/91 FINISH 3/14/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	3.8	N/A	LEAN CLAY (CL), pale yellowish brown (10 YR 6/2) with light gray (N7) mottling, dry, hard, fairly blocky		HNu = 0 ppm Rad = 40 cpm P.P. = >4.5 kg/cm^2 Rig chatter
35	35-40	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4) with light gray (N7) mottling, dry, hard, blocky, some black (N1) striations		HNu = 0 ppm Rad = 40 cpm P.P. = >>4.5 kg/cm^2 Rig chatter
40	40-45	5' Continuous	4.2	N/A	LEAN CLAY (CL), same as above except moist and very stiff		HNu = 0 ppm Rad = 40 cpm P.P. = 3.75 kg/cm^2
45	45-50	5' Continuous	4.9	N/A	LEAN CLAY (CL), light grey (N7) to moderate brown (5 YR 3/4), moist very stiff, black (N1) mottling @ lower 3'		HNu = 0 ppm Rad = 55 cpm P.P. = 2.75 kg/cm^2
50	50-55	5' Continuous	4.8	N/A	3.8': LEAN CLAY (CL), same as above except wet 1': WELL GRADED SAND WITH CLAY (SW), moderate red (5 R 5/4) to light grey (N7), wet, medium to fine grained sand		HNu = 0 ppm Rad = 40 cpm P.P. = 2.75 kg/cm^2
55	55-60	5' Continuous	3.0	N/A	1': WELL GRADED SAND WITH CLAY (SW), same as above 2': WELL GRADED SAND (SW), moderate brown (5 YR 3/4), wet, fine to medium grained sand, micaceous		HNu = 0 ppm Rad = 45 cpm P.P. = 2.75 kg/cm^2 for CL
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.FS	H268	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION West End of Jim Allen Road

ELEVATION 367.37 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig: 7-3/4" OD CME Augers: 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 2/14/91 FINISH 2/14/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	3.4	N/A	WELL GRADED SAND (SW), moderate brown (5 YR 3/4), wet, medium to fine grained		HNu = 0 ppm Rad = 40 cpm P.P. = N/A
65	65-70	5' Continuous	4.4	N/A	WELL GRADED SAND WITH GRAVEL (SW), moderate brown (5 YR 3/4), wet, medium to fine grained sands, well rounded gravel, micaceous sand		HNu = 0 ppm Rad = 40 cpm P.P. = N/A
70	70-75	5' Continuous	3.1	N/A	WELL GRADED SAND WITH GRAVEL (SW), same as above except larger (app. 1" diameter), chert pieces		HNu = 0 ppm Rad = P.P. = N/A Sampler wet
75	75-80	5' Continuous	3.0	N/A	WELL GRADED SAND WITH GRAVEL (SW), same as above		HNu = 0 ppm Rad = P.P. = N/A Sampler wet
80	80-85	5' Continuous	0.3	N/A	WELL GRADED SAND WITH GRAVEL (SW), same as above		HNu = 0 ppm Rad = P.P. = N/A Gravel stuck in catcher- low recovery
85	85-90	5' Continuous	4.2	N/A	0.2': WELL GRADED GRAVEL (GW), moderate brown, (5 YR 3/4), wet 0.3': SANDY LEAN CLAY (CL), light grey (N7), moist, stiff End of Boring		HNu = 0 ppm Rad = P.P. = N/A for GW P.P. = 1.25 kg/cm^2 for CL
90							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	H270	SHEET 1 OF 2

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation   LOCATION: Old Raw Water Line

ELEVATION: 360.73 NGVD   DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A   START: 3/18/91 10:20   FINISH: 3/18/91 15:35   LOGGER: E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL PAD		Bkgd: HNu=0 ppm; Rad=33 cpm
	0-5	5' Continuous	5.0	N/A	LEAN CLAY (CL), light olive gray (5 Y 6/1) with some dark yellowish brown (10 YR 5/4), moist		HNu = 0 ppm Rad = 40 cpm Pocket Pen (P.P.) = 1.75-4.25 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	Top 6" : LEAN CLAY (CL), same as above LEAN CLAY (CL), dark yellowish orange (10 YR 6/6) with presence of dark organic material; crumbly, yet moist		HNu = 0 ppm Rad = 76 cpm P.P. = 1.5-2.75 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above with light olive gray (5 Y 6/1) coloring		HNu = 0 ppm Rad = 43 cpm P.P. = 2.25-3.25 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 42 cpm P.P. = 3.0->4.5 kg/cm^2
20	20-25	5' Continuous		N/A	Top 9" : LEAN CLAY (CL), same as above with no organics SANDY LEAN CLAY (CL), light olive gray (5 Y 6/1), with dark yellowish orange (10 YR 6/6), mottling		HNu = 0 ppm Rad = 32 cpm P.P. = 3.25-3.75 kg/cm^2
25	25-30	5' Continuous		N/A	SANDY LEAN CLAY (CL), same as above Bottom 4" - CLAYEY SAND (SC), light brown (5 YR 5/6)		HNu = 0 ppm Rad = 59 cpm P.P. = 2.25-4.25 kg/cm^2
30							

PROJECT NUMBER	BORING NUMBER
ORO30888.B1	H270 SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Old Raw Water Line

ELEVATION 360.73 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/18/91 10:20 FINISH 3/18/91 15:35 LOGGER E. Pomar

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	Top 1" : CLAYEY SAND (SC), same as above Next 2'7" - LEAN CLAY (CL), light gray (N7) 2' : SANDY LEAN CLAY (CL), light brown (5 YR 5/6); 2" layered hard organic material Bottom 4" : CLAYEY SAND (SC), light brown (5 YR 5/6)		HNu = 0 ppm Rad = 43 cpm P.P. = 1.25-2.25 kg/cm^2
35	35-40	5' Continuous	1.6	N/A	SANDY LEAN CLAY (CL) to CLAYEY SAND (SC), light brown (5 YR 5/6) with some organic material		HNu = 0 ppm Rad = 46 cpm P.P. = 1.25-1.75 kg/cm^2
40	40-45	5' Continuous	3.5	N/A	SANDY LEAN CLAY (CL) to CLAYEY SAND (SC), same as above but wet		HNu = 0 ppm Rad = 40 cpm P.P. = N/A
45	45-50	5' Continuous	3.0	N/A	Top 1' : SANDY LEAN CLAY (CL) to CLAYEY SAND (SC), same as above Bot. 2' : CLAYEY SAND (SC), dark yellowish orange (10 YR 6/6)		HNu = 0 ppm Rad = 43 cpm P.P. = N/A
50	50-55	5' Continuous	3.0	N/A	SANDY LEAN CLAY (CL) to CLAYEY SAND (SC), same as above, very wet		HNu = 0 ppm Rad = 24 cpm P.P. = N/A
55	55-60	5' Continuous	2.0	N/A	SANDY LEAN CLAY (CL) to CLAYEY SAND (SC), same as above, very wet Bot. 7.5" : WELL GRADED GRAVEL W/SAND (GW), dark yellowish orange (10 1/R 6/6)		HNu = 0 ppm Rad = 22 cpm P.P. = N/A Gravel aquifer
60					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H271	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road North of Plant

ELEVATION 364.51 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/18/91 FINISH 3/18/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0-5	5' Continuous	.6	N/A	LEAN CLAY (CL), pale yellowish brown (10 YR 6/2), with mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 1.0-2.0 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except lower 3.0' lower moisture content		HNu = 0 ppm Rad = 30 cpm P.P. = 1.5-2.5 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), pale yellowish brown (10 YR 6/2) with mottling, dry, hard. Note: dry strength-medium		HNu = 0 ppm Rad = 30 cpm P.P. = >4.5 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
20	20-25		5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
25	25-30		4.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 4/4), with mottling, moist, hard		HNu = 0 ppm Rad = 30 cpm P.P. = 4.5 kg/cm^2 Catcher in backwards
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.FS	H271 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road North of Plant

ELEVATION 364.51 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/18/91 FINISH 3/18/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
35	35-40	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate reddish brown (10 R 4/6), moist, very stiff		HNu = 0 ppm Rad = 50 cpm P.P. = 2.5-3.5 kg/cm^2
40	40-45	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except trace sand in lower 3.0'		HNu = 0 ppm Rad = 40 cpm P.P. = 2.5-3.5 kg/cm^2
45	45-50	5' Continuous	3.5	N/A	Top 2.0' : SANDY LEAN CLAY (CL), moderate brown (10 YR 5/4), moist, very stiff, sand-medium Bottom 1.5' : CLAYEY SAND (SC), moderate reddish orange (10 R 6/6), wet, soft, sand - medium grained		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2 Top 0.5 kg/cm^2 Bottom
50	50-55	5' Continuous	4.0	N/A	POORLY GRADED SAND (SP), moderate reddish brown (10 R 4/6), wet, sand - fine to medium, contained mica flakes		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
55	55-60	5' Continuous	4.0	N/A	POORLY GRADED SAND (SP), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H271	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Boldry School Road North of Plant

ELEVATION 364.51 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/18/91 FINISH 3/18/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	3.0	N/A	POORLY GRADED SAND (SP), same as above except coarse grained		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Driller notes gravel at 61'+; gravels in catcher
65					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ORO30888.BI	H272 SHEET 1 OF 2

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: No. End of No. Extention of Harmony Cemetary Rd

ELEVATION: 361.51 NGVD DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 3/20/91 FINISH: 3/20/91 LOGGER: G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=35 cpm
	0-5	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4), moist, stiff, some light gray (N7), streaking		HNu = 0 ppm Rad = 40 cpm Pocket Pen (P.P.) = 1.5 kg/cm^2
5	5-10	5' Continuous	4.9	N/A	LEAN CLAY (CL), same as above except for brownish black (5 YR 2/1), mottling		HNu = 0 ppm Rad = 35 cpm P.P. = 1.25 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except for very stiff		HNu = 0 ppm Rad = 40 cpm P.P. = 3.0 kg/cm^2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6) with light gray (N7) streaking, moist, very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 3.75 kg/cm^2
20	20-25	5' Continuous	5.0	N/A	2.5': LEAN CLAY (CL), same as above 2.5': LEAN CLAY (CL), light bluish gray (5 B 7/1), moist, very stiff, small % of fine grained sand in clay		HNu = 0 ppm Rad = 40 cpm P.P. = 3.0 kg/cm^2 for bottom 2.5'
25	25-30	5' Continuous	4.9	N/A	2.0': WELL GRADED SAND (SW), medium light gray (N6), wet, fine to medium grained sand 2.9': LEAN CLAY (CL), light brown (5 YR 5/6), moist, very stiff, small % of fine grained sand		HNu = 0 ppm Rad = 40 cpm P.P. = 3.1 kg/cm^2 for CL
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.BI	H272	SHEET 2 OF 2

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION No. End of No. Extention of Harmony Cemetary Rd

ELEVATION 361.51 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

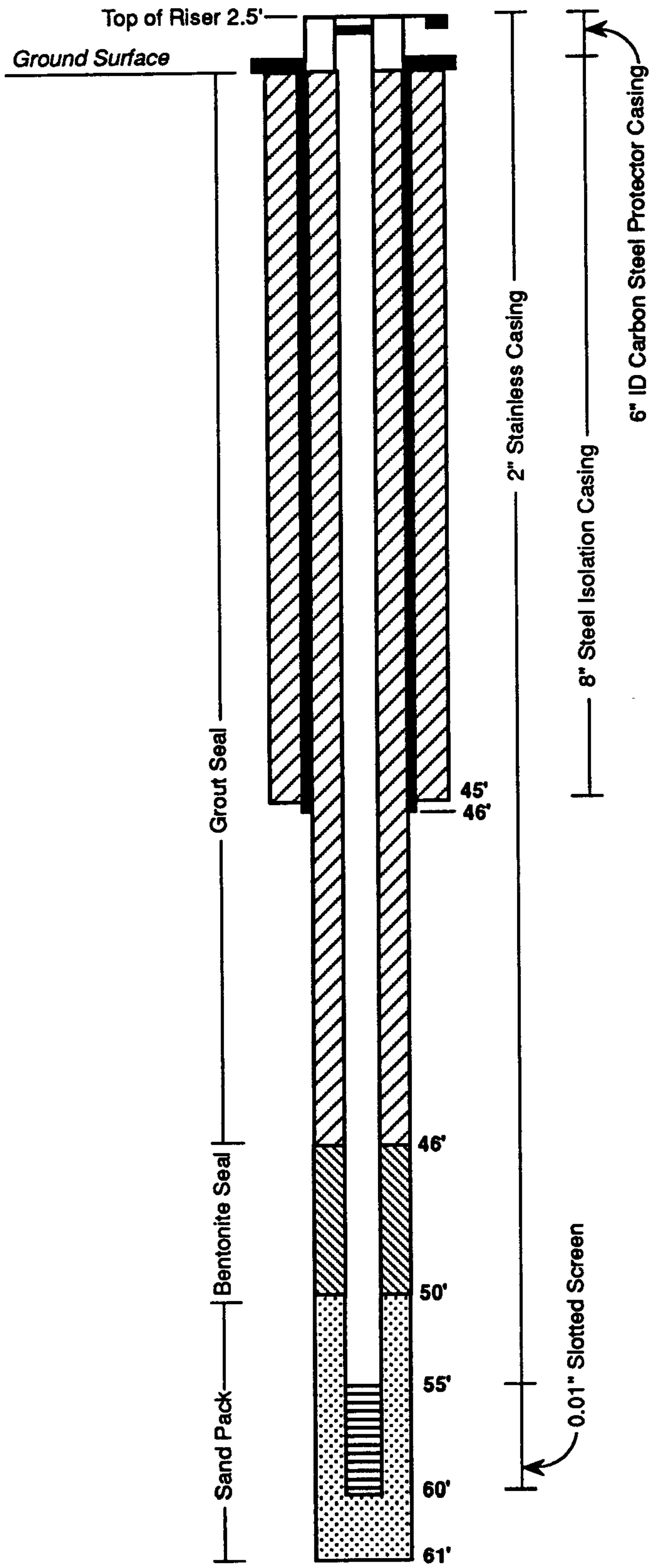
DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/20/91 FINISH 3/20/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=35 cpm
	30-35	5' Continuous	5.0	N/A	LEAN CLAY WITH SAND (CL), light brown (5 YR 5/6) with light gray (N7) streaking, wet, very stiff, pale yellowish orange (10 YR 8/6), mottling, fine grained sand		HNu = 0.5 ppm Rad = 50 cpm Pocket Pen (P.P.) = 3.0 kg/cm^2
35	35-40	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate brown (5 YR 3/4) with light gray mottling (N7), moist, hard		HNu = 0 ppm Rad = 40 cpm P.P. = 4.0 kg/cm^2
40	40-45	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except slightly micaceous		HNu = 0 ppm Rad = 45 cpm P.P. = 2.25 kg/cm^2
45	45-50	5' Continuous	4.7	N/A	LEAN CLAY (CL), same as above except for small % of fine grained sand in the clay at bottom 0.4'		HNu = 0 ppm Rad = 40 cpm P.P. = 3.0 kg/cm^2
50	50-55	5' Continuous	0.6	N/A	WELL GRADED SAND WITH GRAVEL (SW), moderate brown (5 YR 4/4), wet, medium to coarse grained sand, well rounded chert gravel		HNu = 0 ppm Rad = 35 cpm P.P. =N/A Sampler wet out of hole
55	55-60	5' Continuous	2.0	N/A	WELL GRADED GRAVEL WITH SAND (GW), moderate brown (5 YR 4/4),wet, medium to coarse grained sand, well rounded chert gravel End of boring		HNu = 0 ppm Rad = 50 cpm P.P. =N/A Sampler wet out of hole
60							

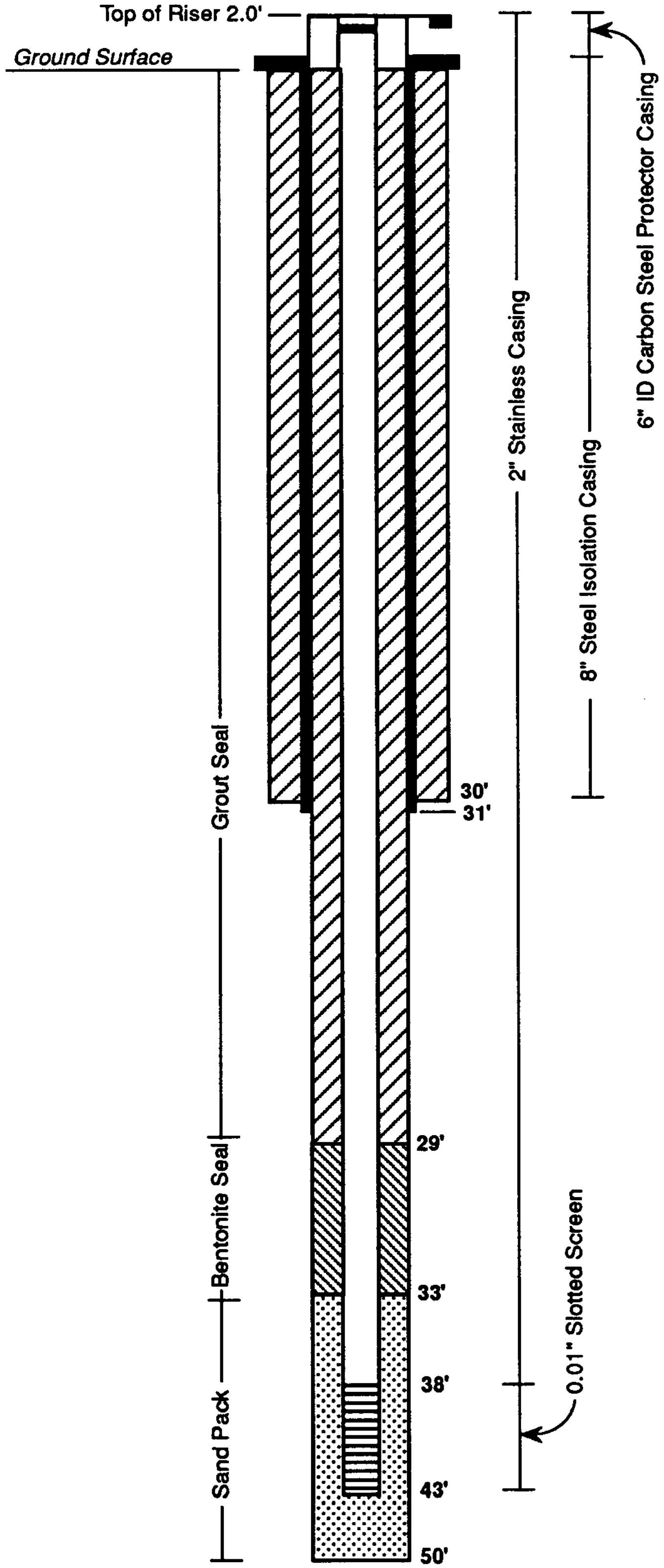
Attachment 5-C

WELL INSTALLATION LOGS



WELL CONSTRUCTION DETAILS
MW191

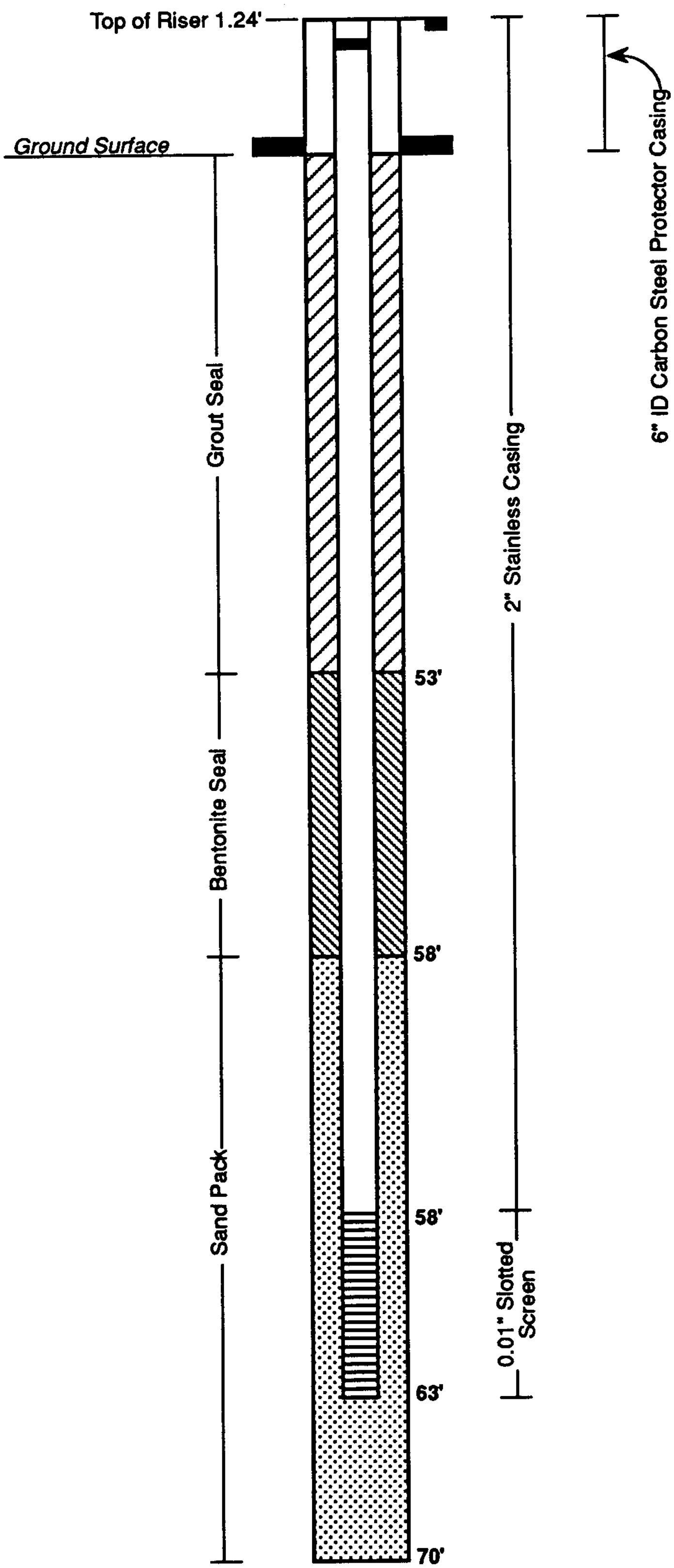
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



NOTE:
6" of stainless steel
stick-up added on 4/22/91

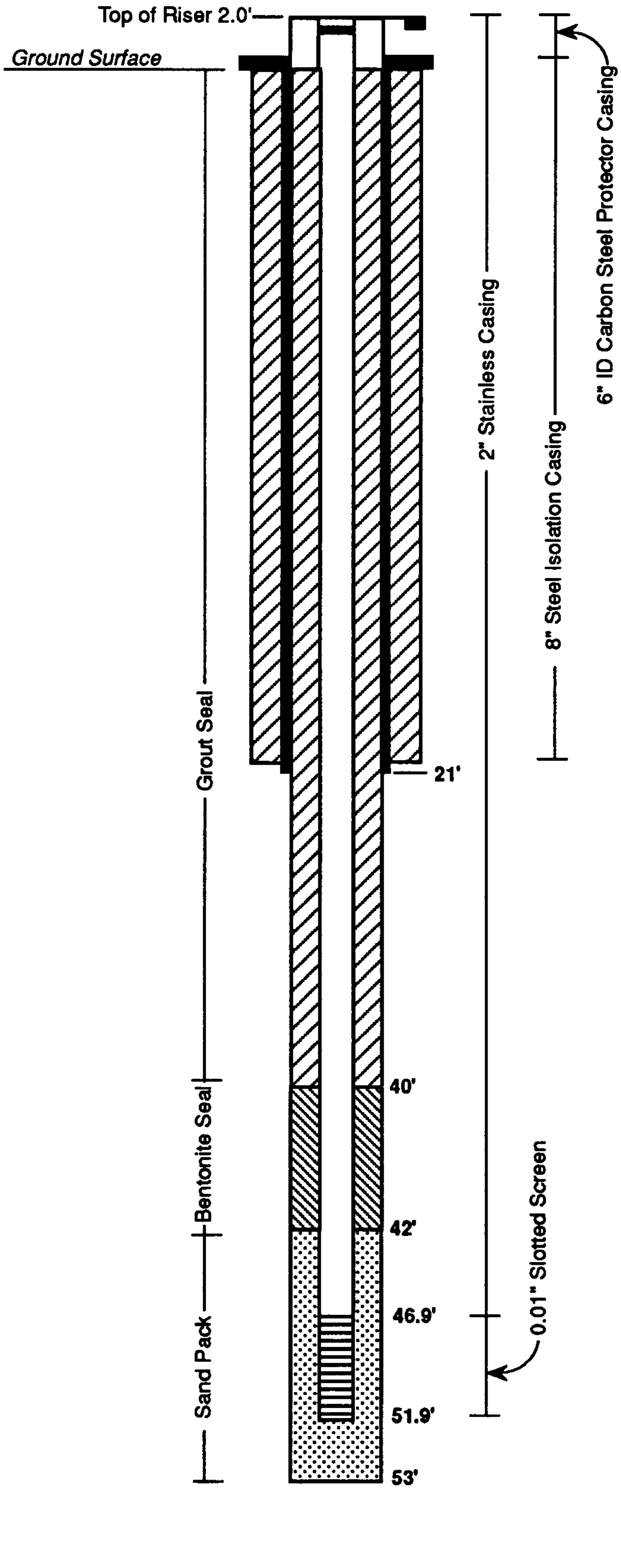
WELL CONSTRUCTION DETAILS
MW192

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



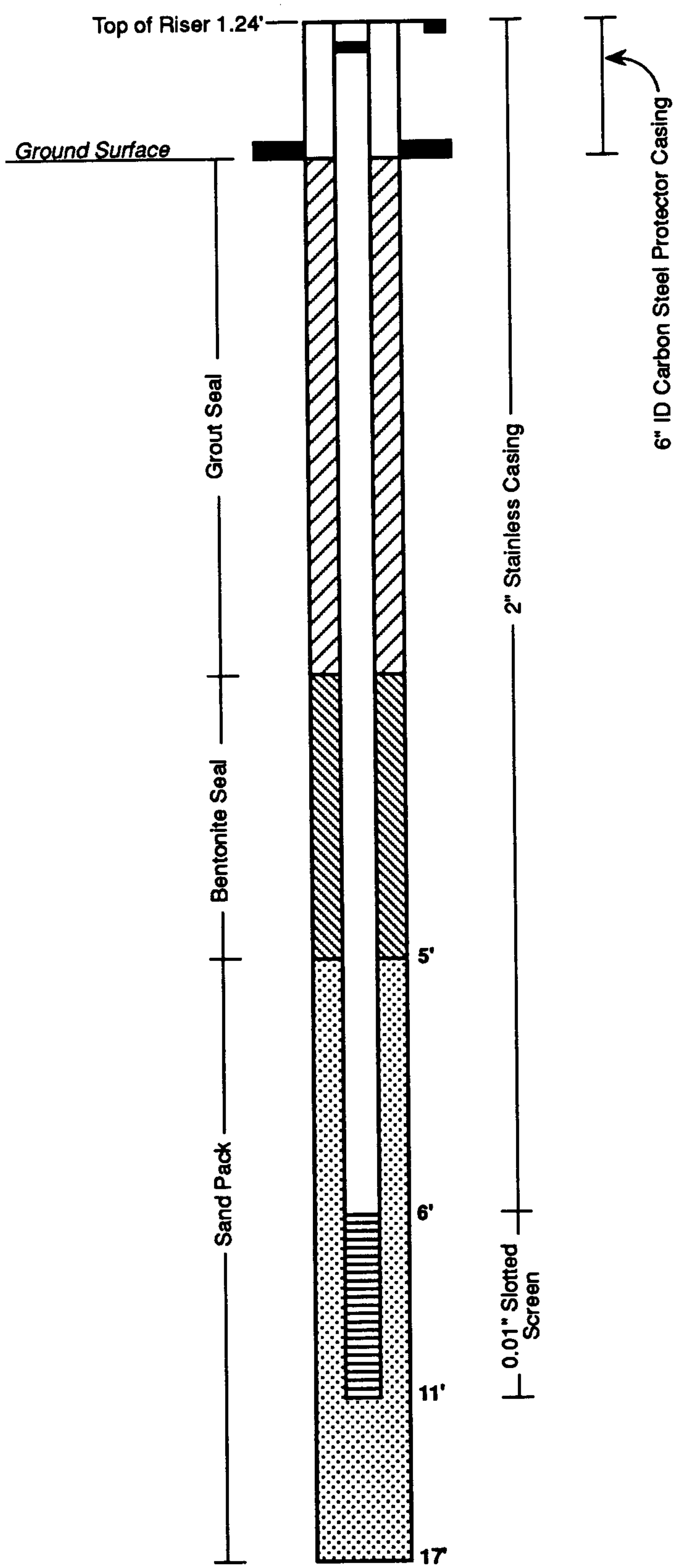
WELL CONSTRUCTION DETAILS
MW193

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



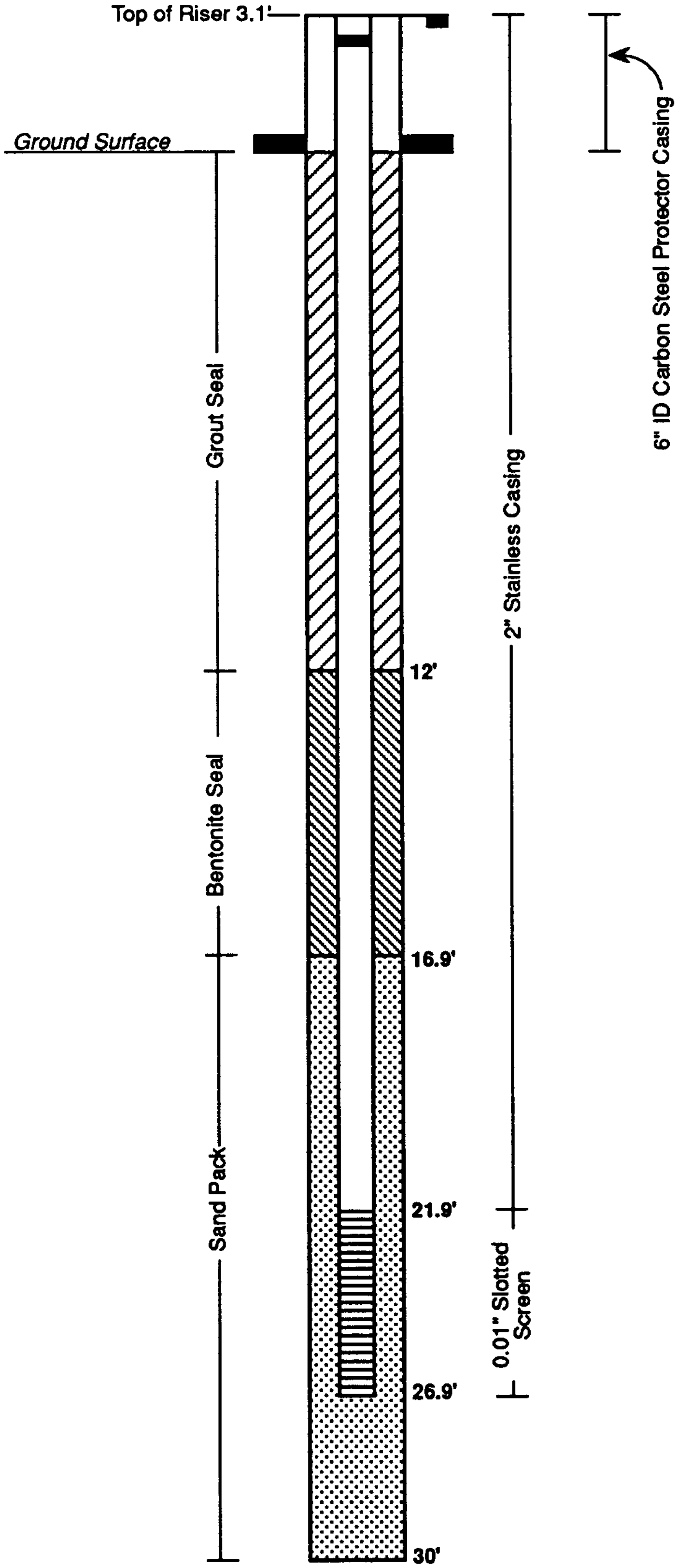
WELL CONSTRUCTION DETAILS
MW194

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



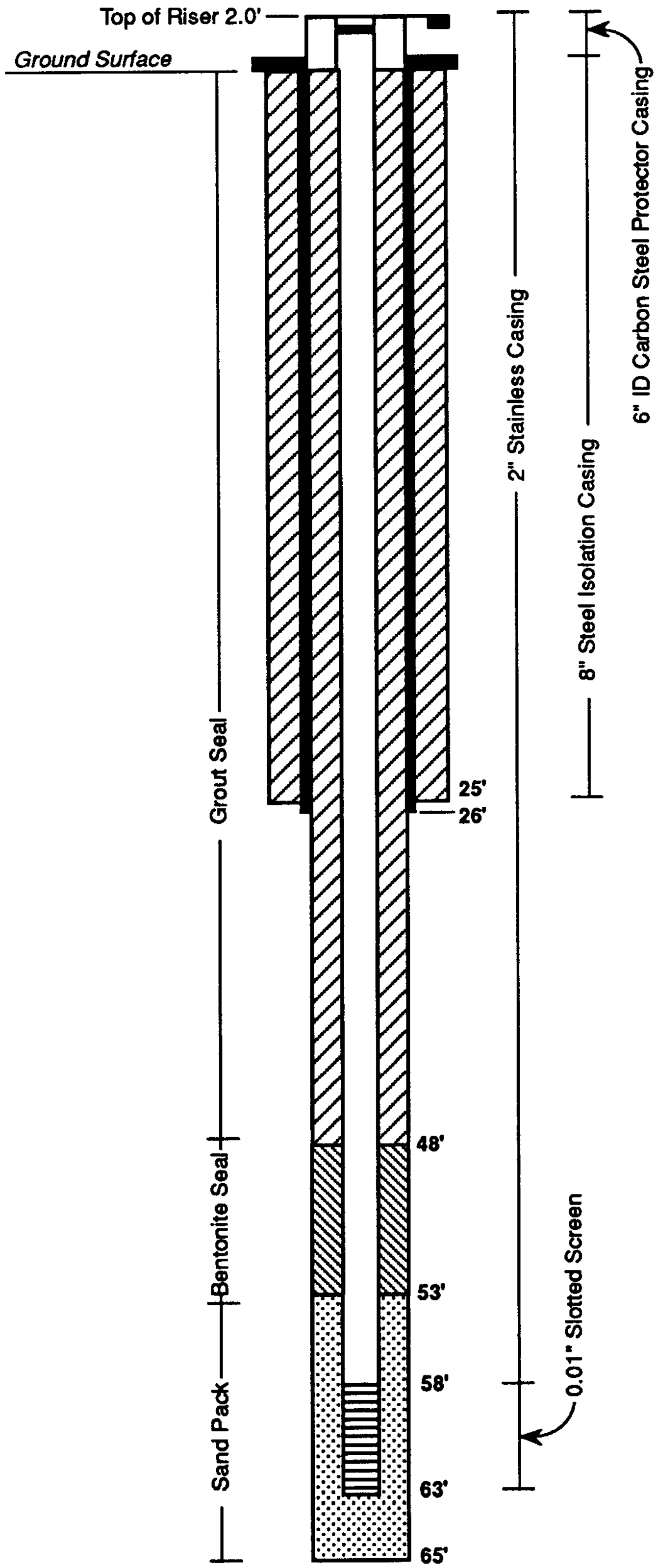
WELL CONSTRUCTION DETAILS
MW195

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



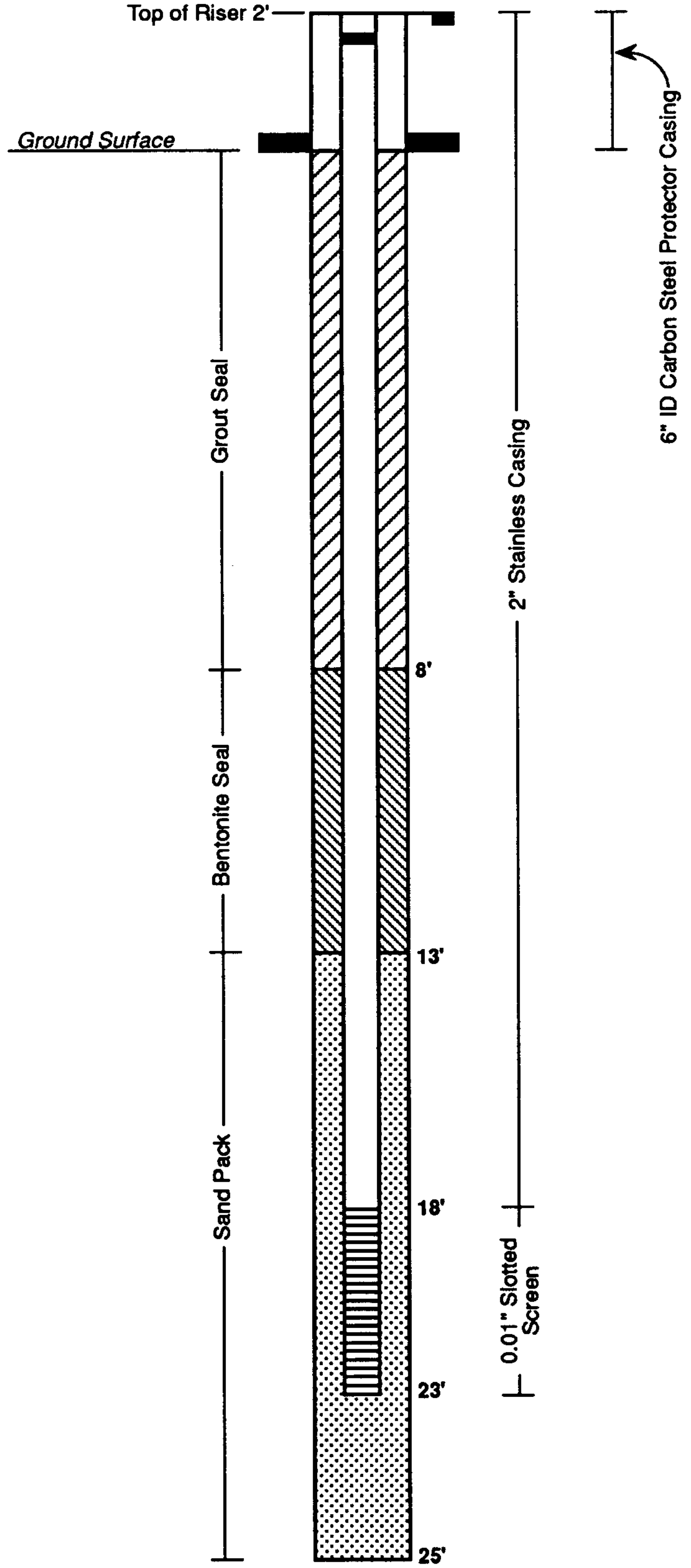
WELL CONSTRUCTION DETAILS
MW196

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



WELL CONSTRUCTION DETAILS
MW197

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



WELL CONSTRUCTION DETAILS
MW198

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
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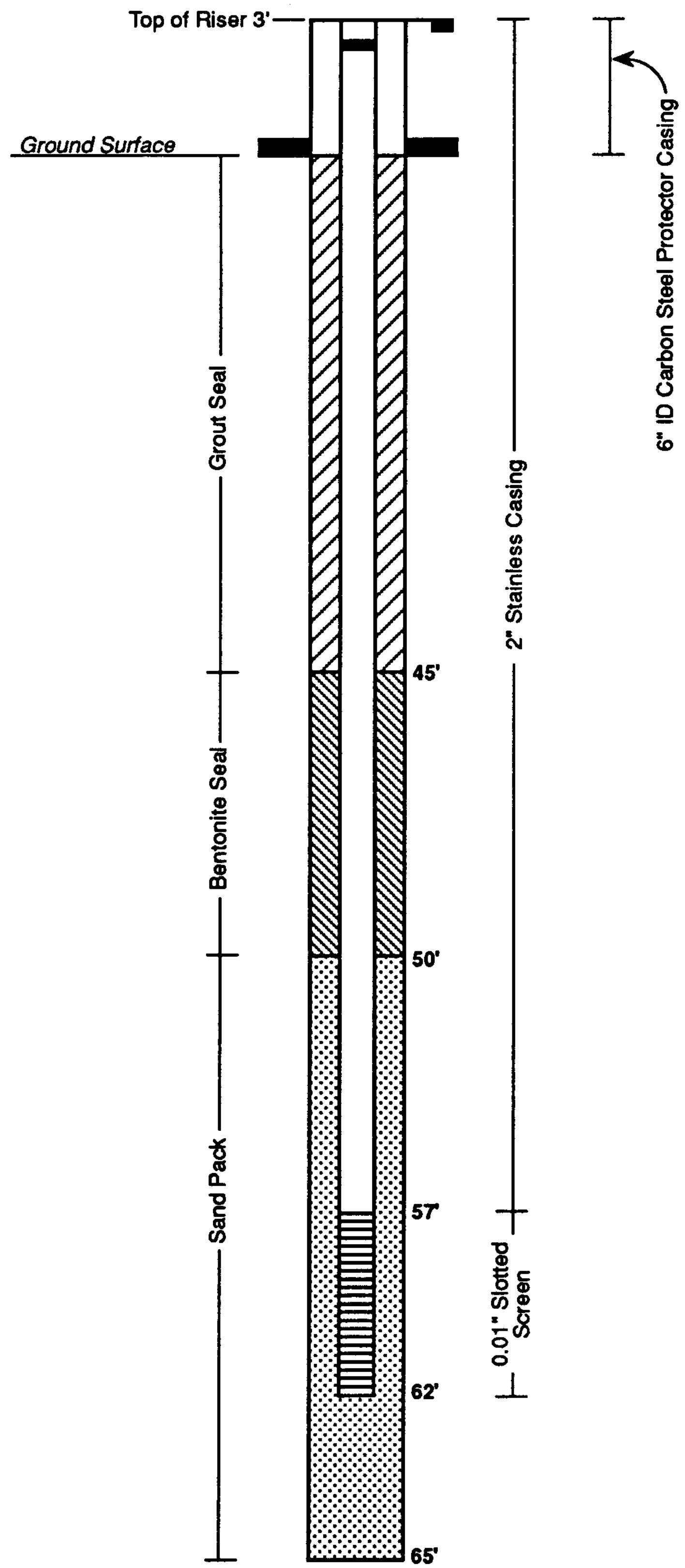
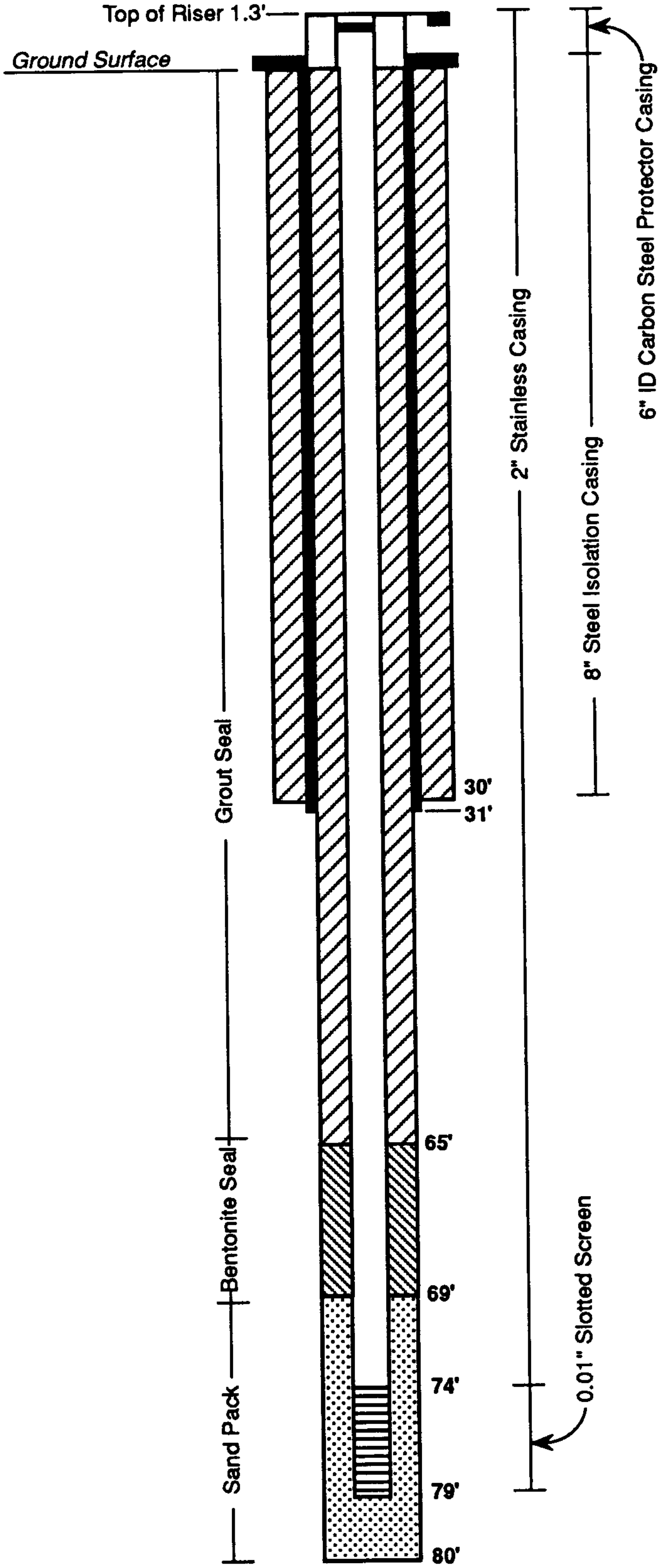


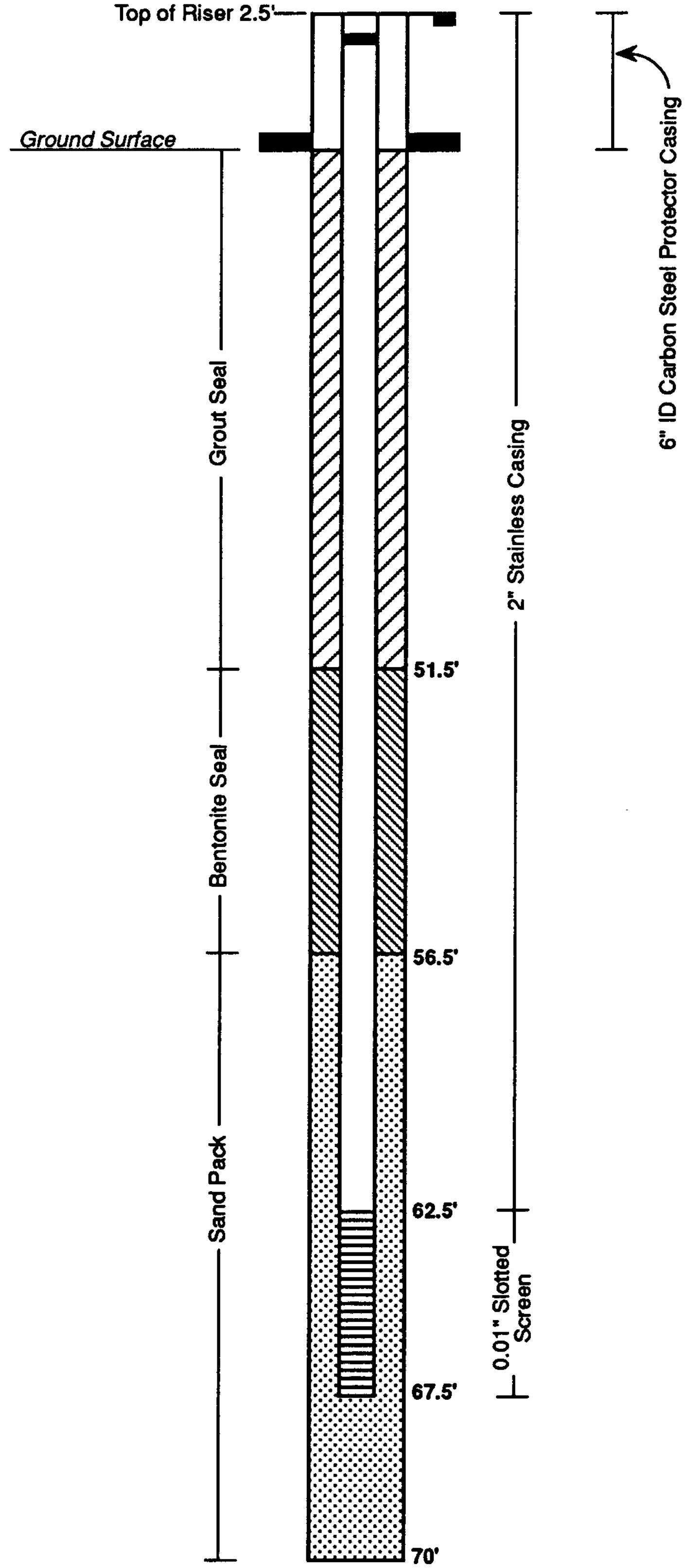
WELL CONSTRUCTION DETAILS
MW199

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



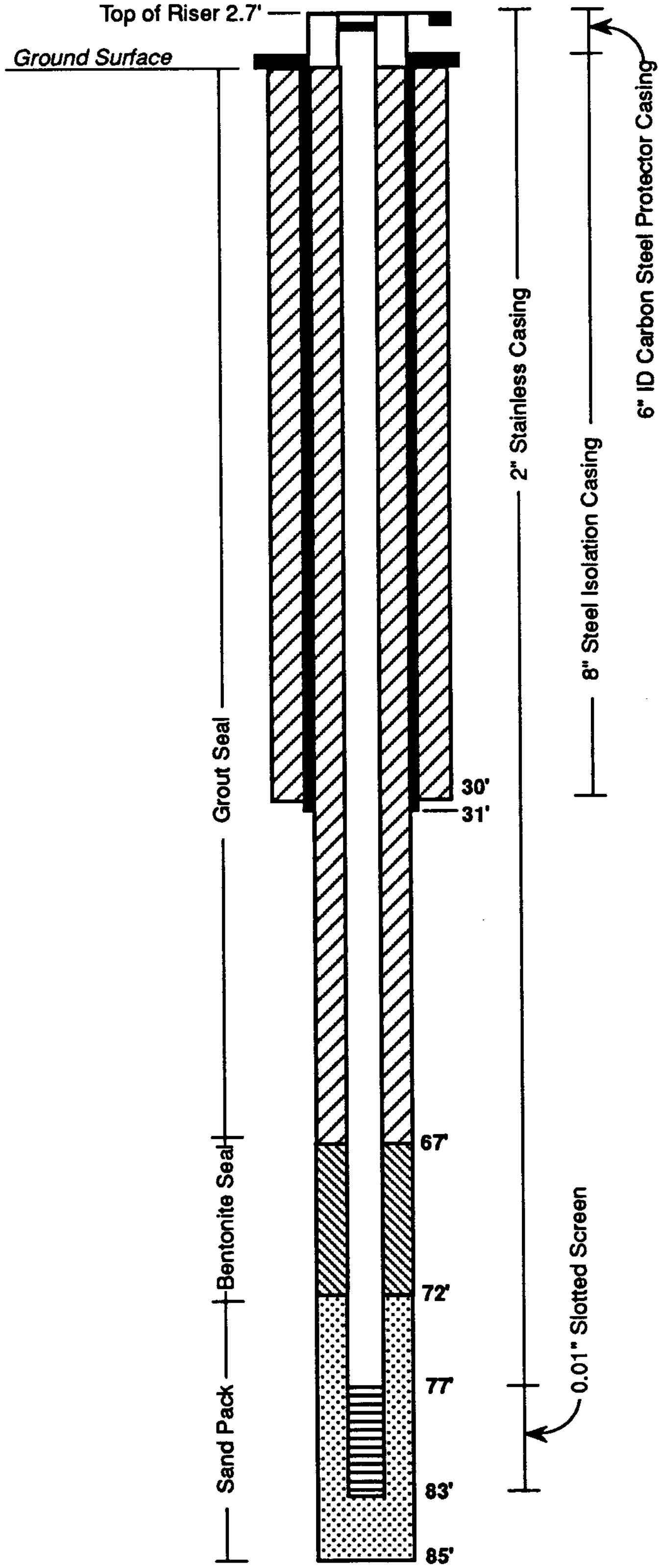
WELL CONSTRUCTION DETAILS
MW200

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



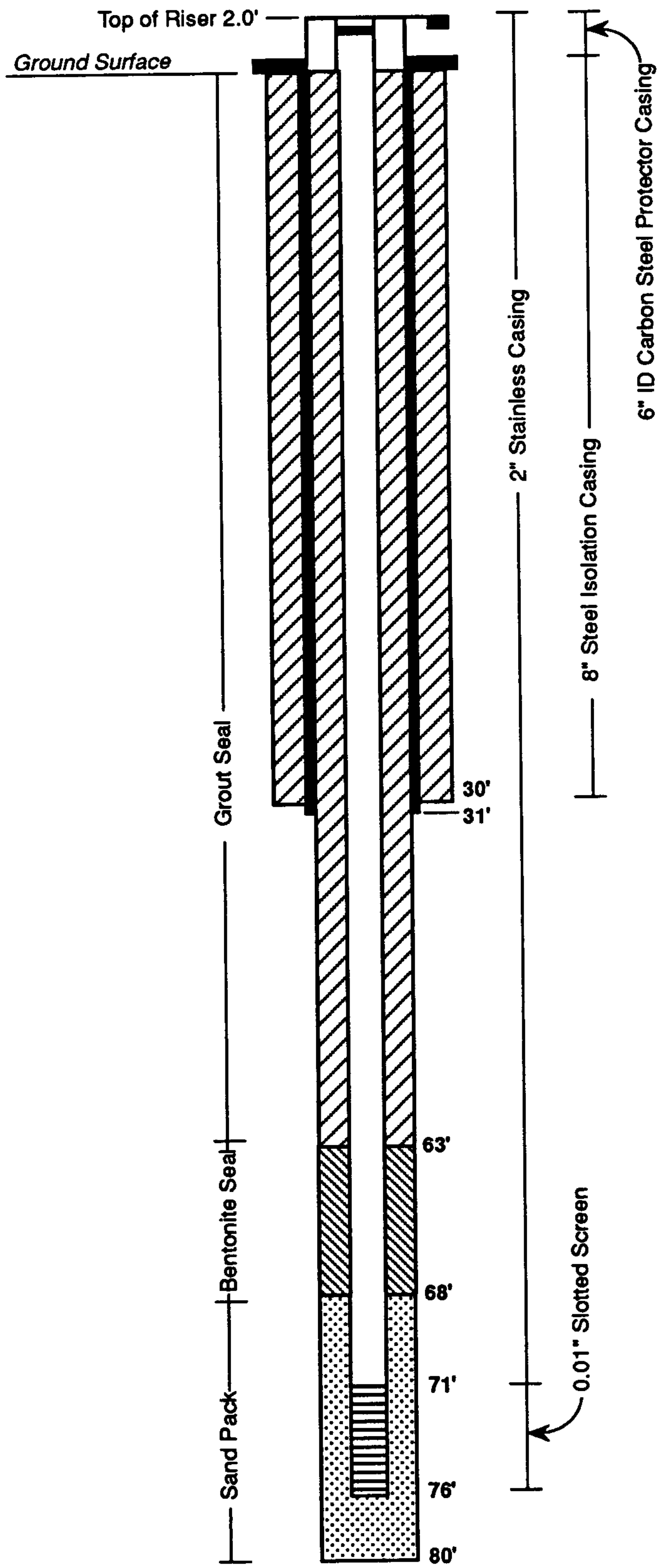
WELL CONSTRUCTION DETAILS
MW201

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



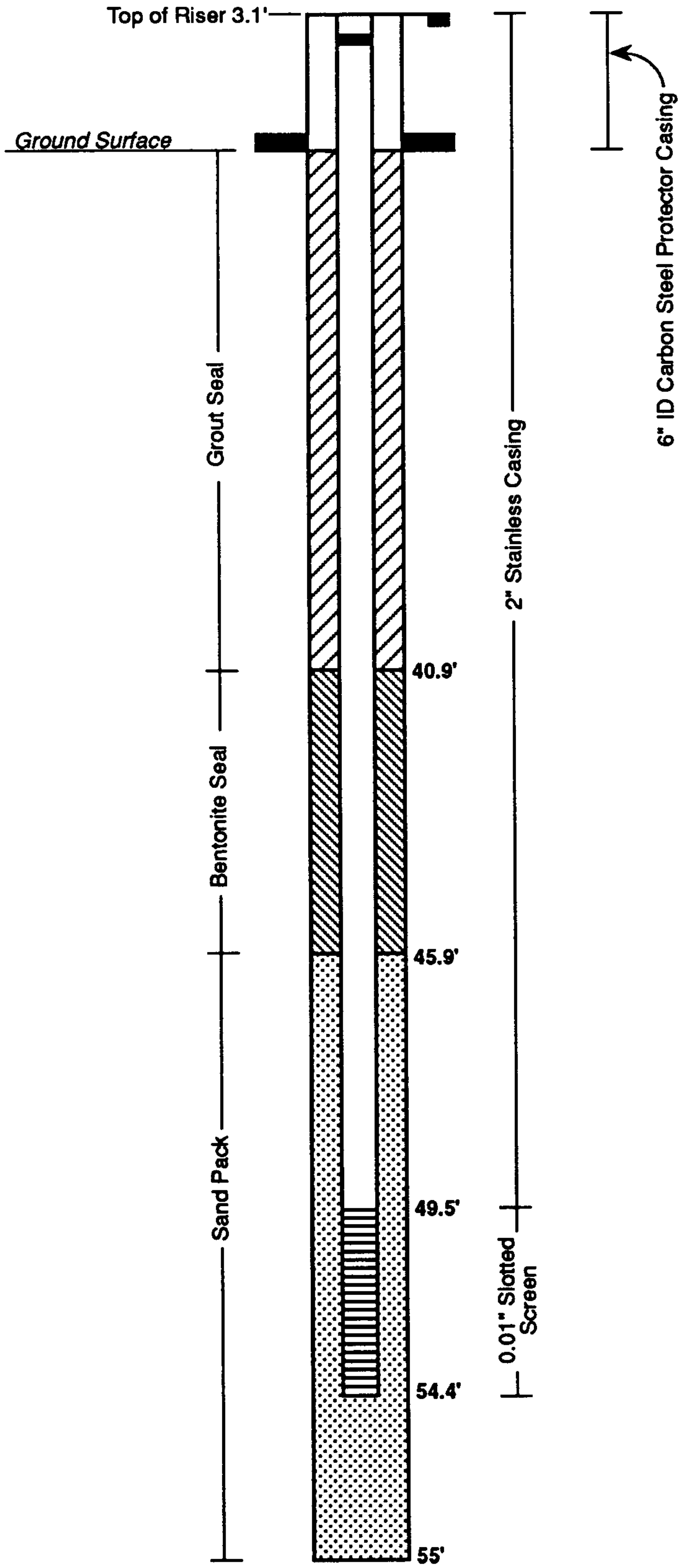
WELL CONSTRUCTION DETAILS
MW202

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



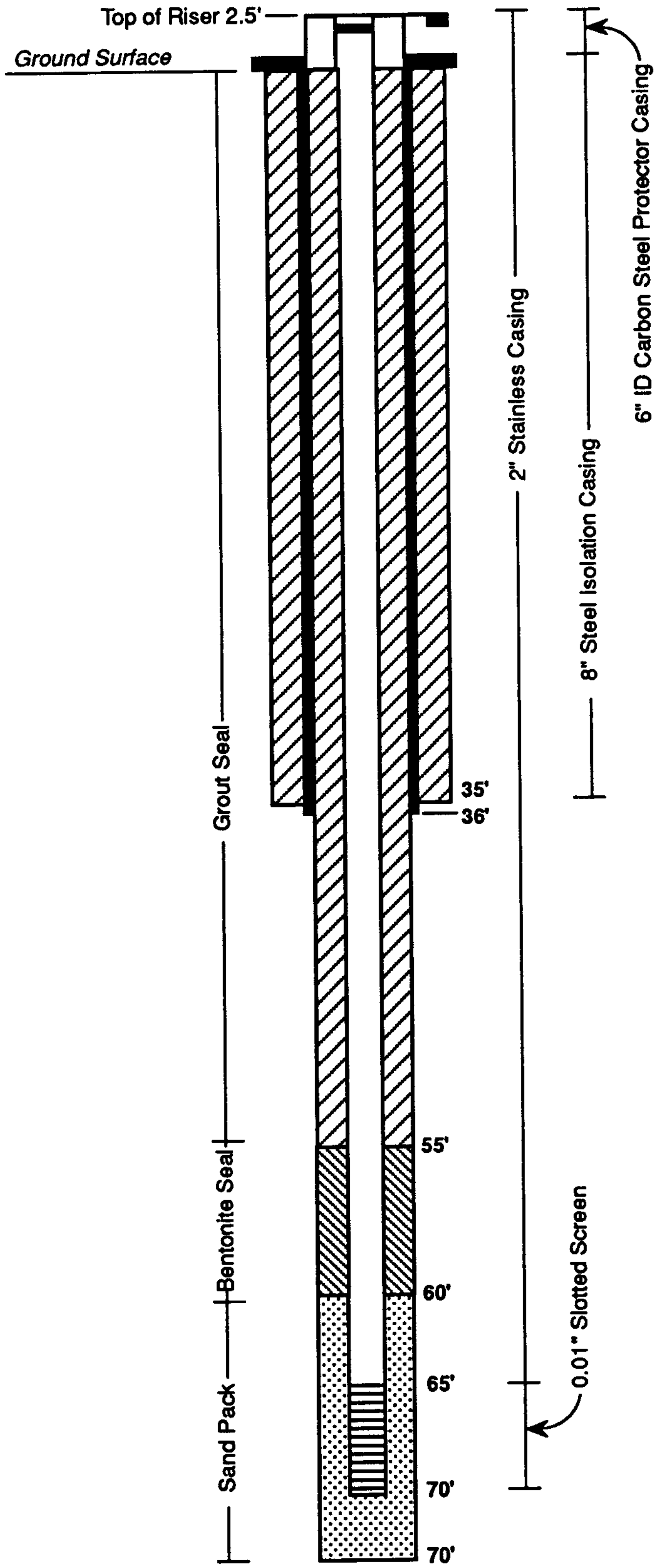
WELL CONSTRUCTION DETAILS
MW203

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



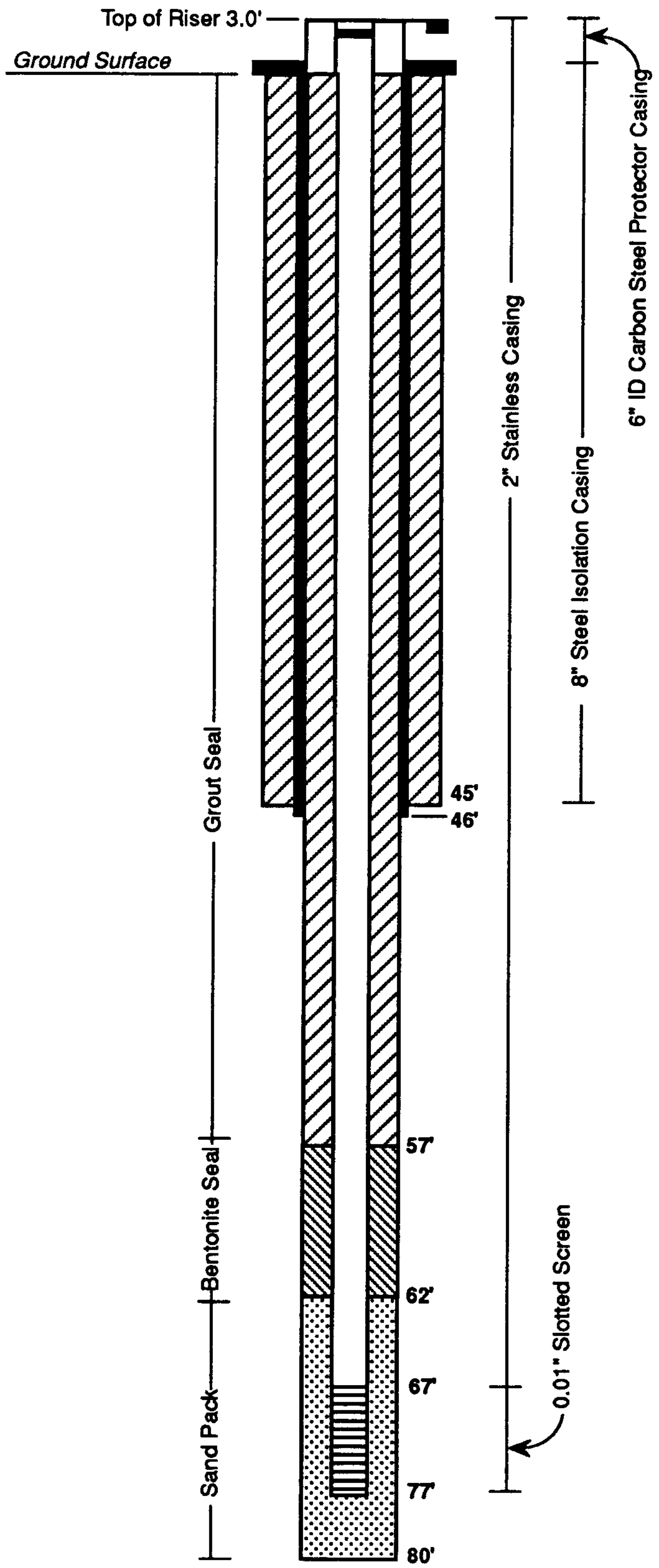
WELL CONSTRUCTION DETAILS
MW204

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



WELL CONSTRUCTION DETAILS
MW205

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION



WELL CONSTRUCTION DETAILS
MW206

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

Attachment 5-D

WELL INSTALLATION PAD DIAGRAMS

ORO30888.BI

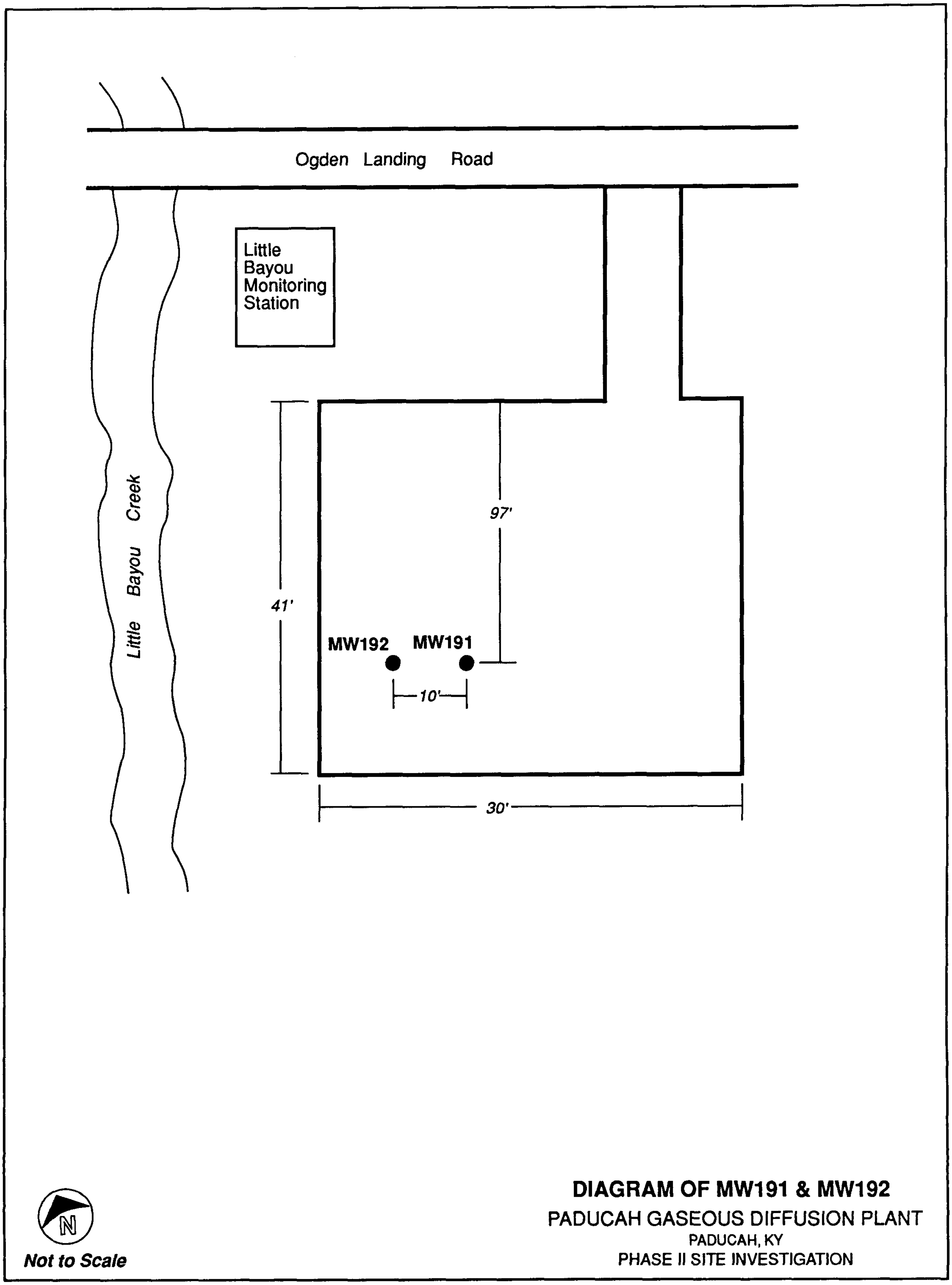


DIAGRAM OF MW191 & MW192

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY

PHASE II SITE INVESTIGATION

ORO30888.BI

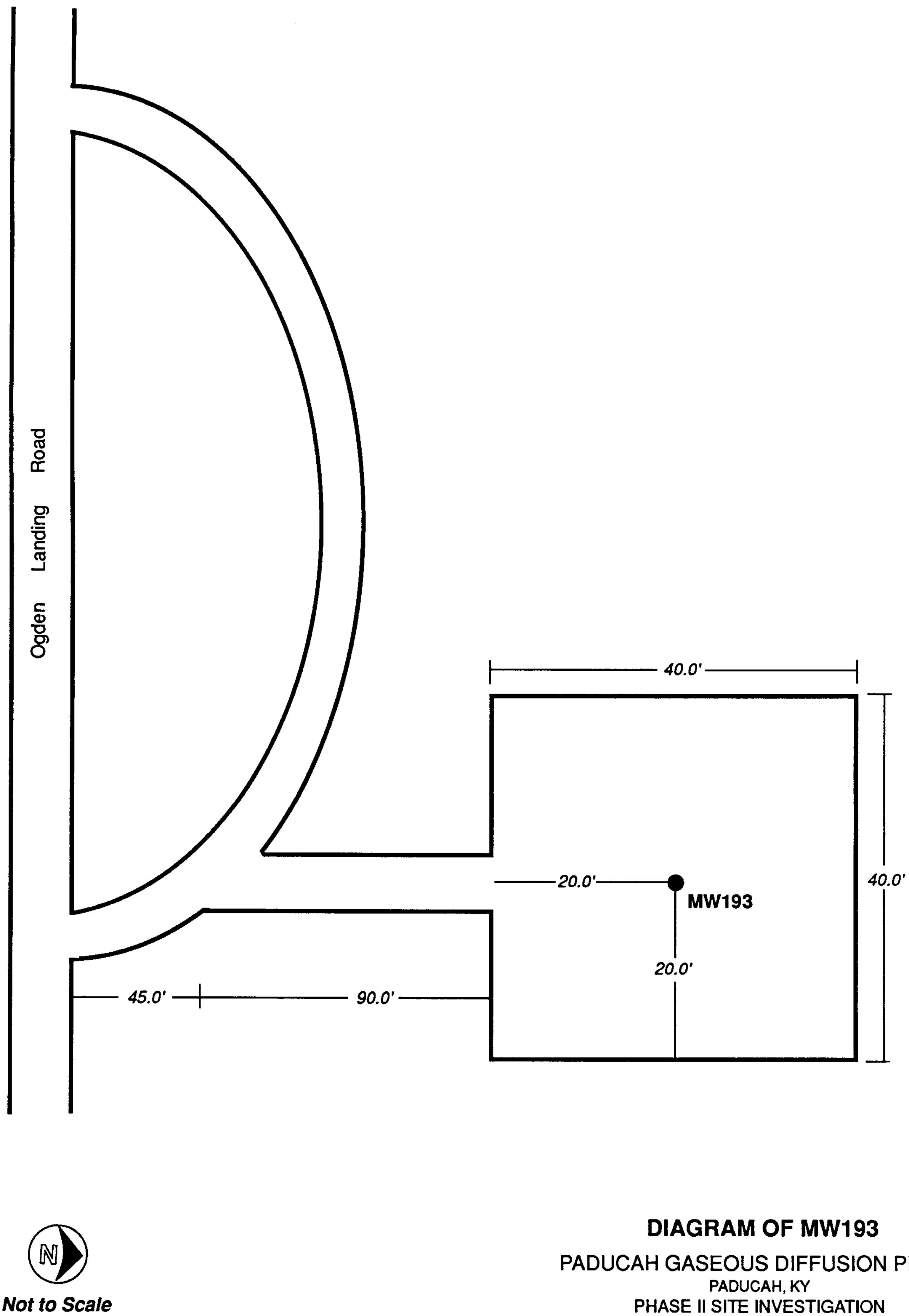


DIAGRAM OF MW193

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

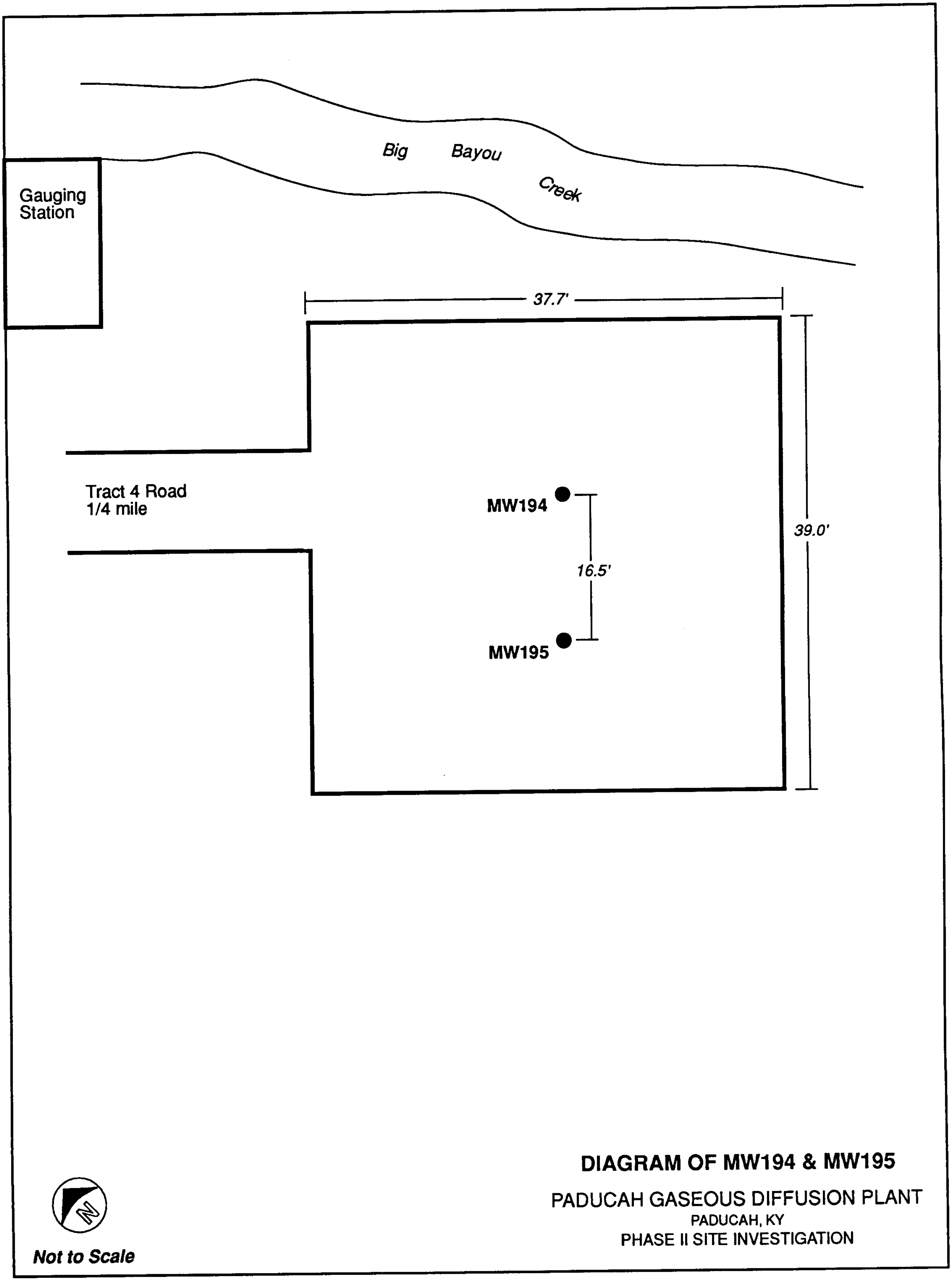


DIAGRAM OF MW194 & MW195

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

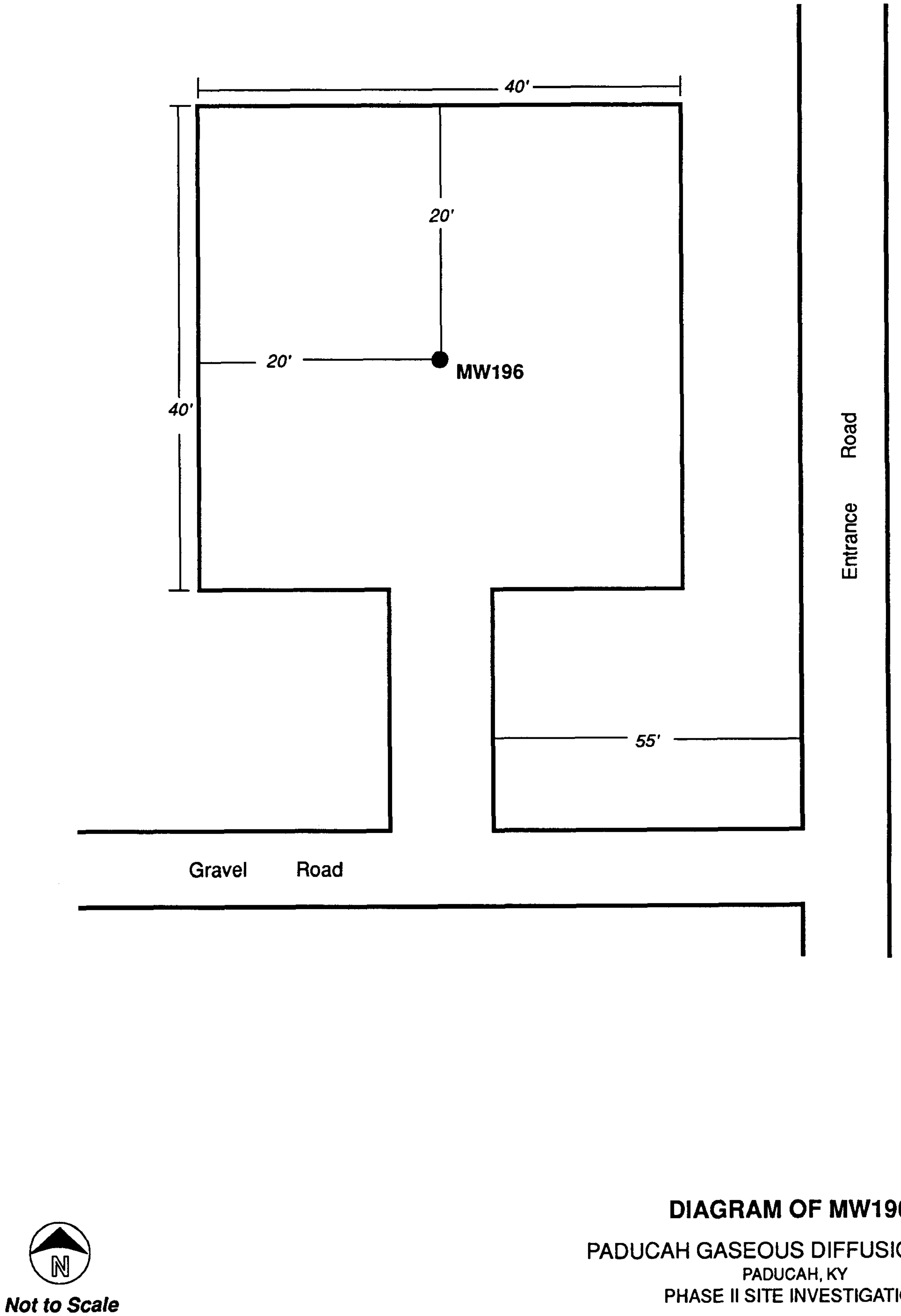


DIAGRAM OF MW196

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

ORO30888.BI

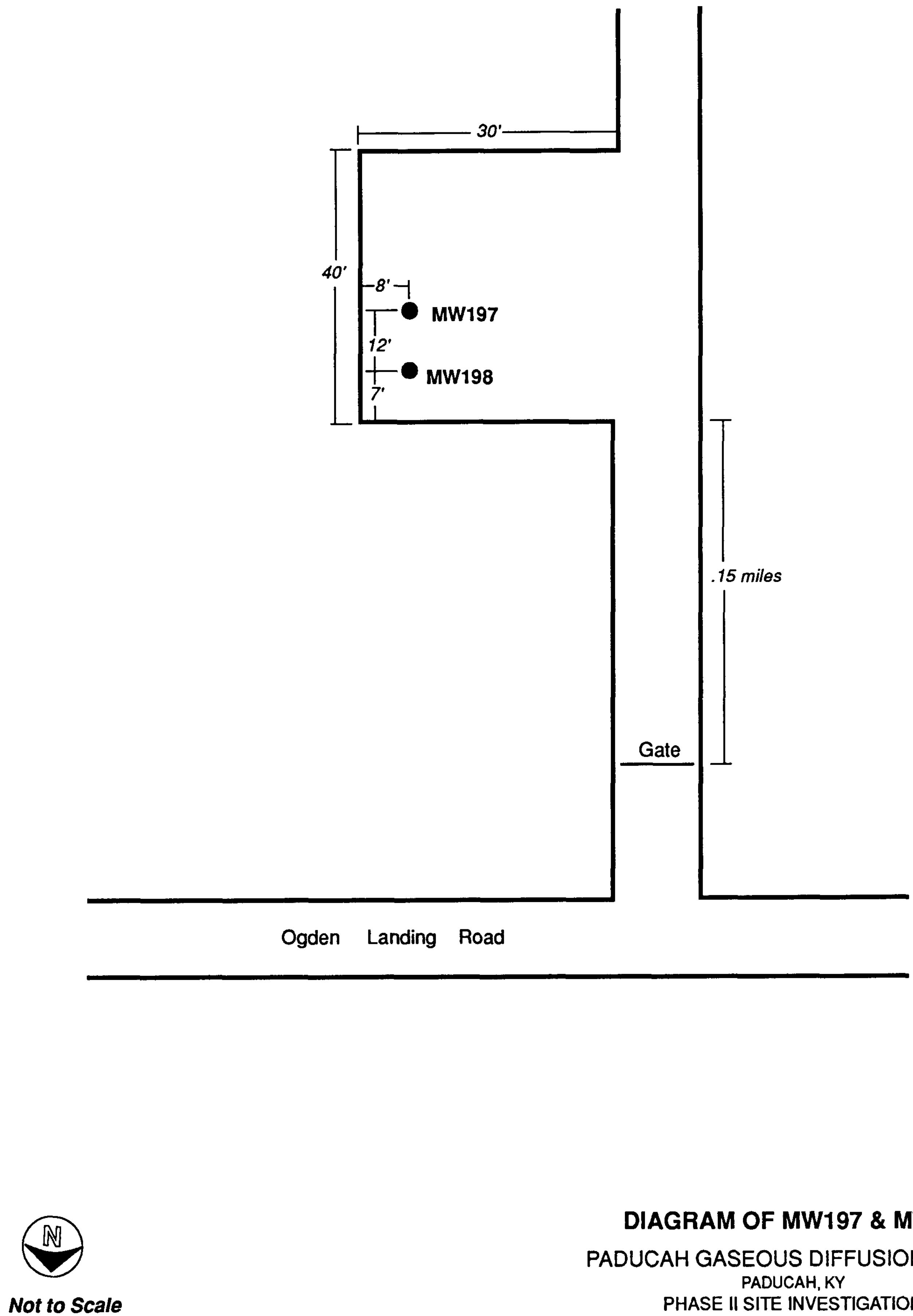


DIAGRAM OF MW197 & MW198

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

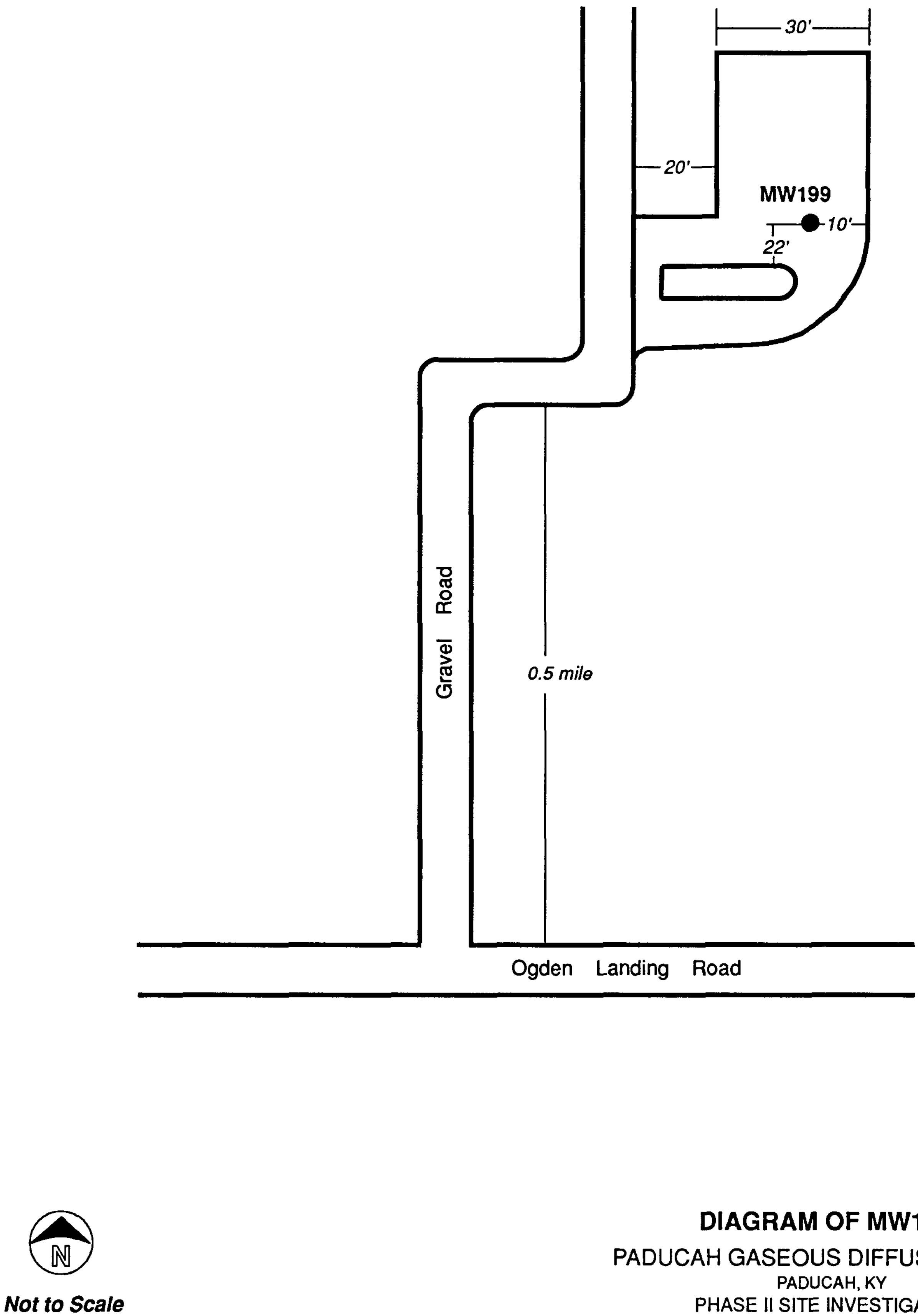


DIAGRAM OF MW199

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY

PHASE II SITE INVESTIGATION

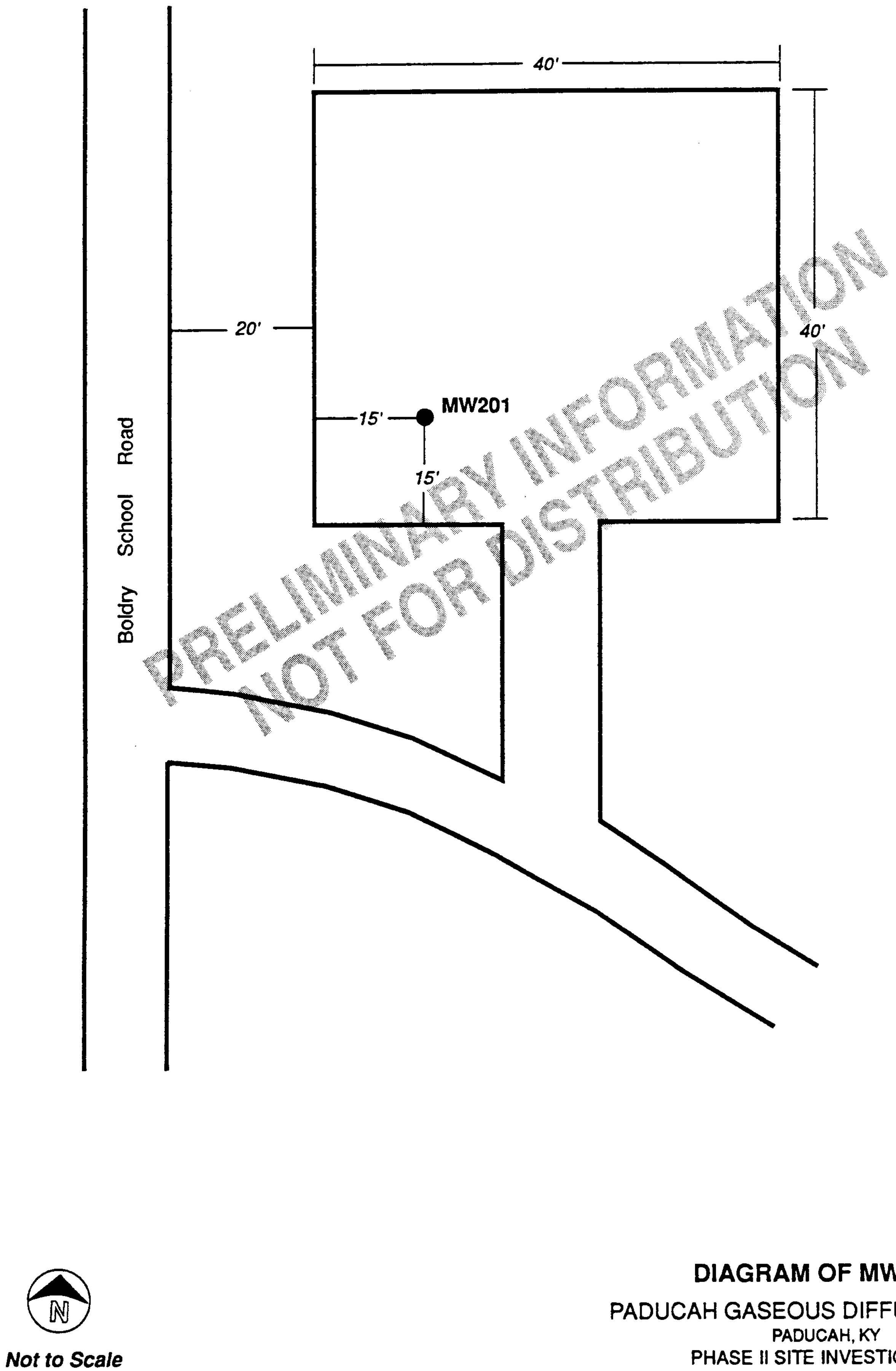
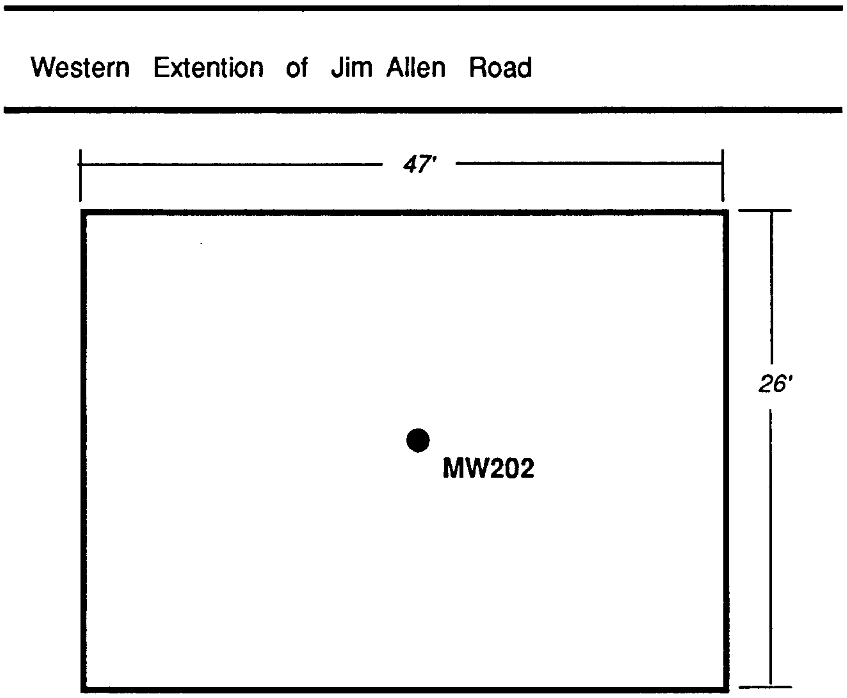


DIAGRAM OF MW201

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY

PHASE II SITE INVESTIGATION



Not to Scale

DIAGRAM OF MW202

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

APPENDIX 2B-6
Aquifer Recovery Slug Testing

TECHNICAL MEMORANDUM NO. 6
PGDP PHASE II SITE INVESTIGATION

PREPARED BY: Mary Kate Dwyer/NJO
Alan Eddebbarh/DEN

SUBJECT: Aquifer Recovery Slug Testing

PROJECT NO.: NJO30888.FA

INTRODUCTION

PURPOSE AND SCOPE

Instantaneous recovery (slug) tests were performed as part of the Phase II Site Investigation to characterize the hydraulic properties of selected aquifers and other hydrogeologic units beneath the PGDP. Results of the slug tests provide order-of-magnitude estimates of in situ hydraulic conductivity for a small aquifer volume in the area immediately surrounding the test well. Sets of tests were performed in Phase II well clusters screened in intervals occurring at varying depths within hydrogeologic units. From these tests, the hydraulic conductivities and transmissivities within the various water-bearing zones of interest were determined.

This TM presents the results of the aquifer testing, including a description of the hydrogeologic units tested and the procedures used. Calculated hydraulic conductivities and transmissivities of the aquifers tested are also presented.

BACKGROUND

Hydrogeologic Setting

The unconsolidated sediments that underlie the PGDP are, in ascending order, the McNairy Formation, the Porters Creek Clay, the Eocene sands, the Continental Deposits, and surficial deposits of loess and alluvium. Recovery tests were performed only in the Continental Deposits during the Phase II Site Investigation.

The surficial deposits typically consist of silty clay or clayey silt and are referred to as the post-Continental Deposits. This unit may be a semi-confining layer because of a relatively low hydraulic conductivity.

The Continental Deposits underlying the surficial deposits consist of an upper and a lower unit. The Upper Continental Deposits are predominantly finer-grained clays and silts with interbedded and discontinuous sand lenses, whereas the Lower Continental Deposits are a gravel unit. Saturated sandy zones within the Upper Continental Deposits constitute the shallow groundwater system. Fifteen shallow wells were tested. The Lower Continental Deposits are comprised of the upper and lower Regional Gravel Aquifer (RGA). Wells tested in the upper or lower RGA are screened at the top or bottom portion of the aquifer, respectively. The RGA is a primary water-producing zone. Eighteen wells were tested in the upper and two wells were tested in the lower RGA.

Well Descriptions

Twenty-two of the Stage A onsite wells were tested to obtain measurements representative of the different water-bearing zones and to provide areal coverage of onsite areas near WMUs. Thirteen of the Stage B wells were tested to characterize hydraulic properties of the shallow groundwater system and RGA.

The aquifer recovery tests were performed in three categories of wells representing the specific hydrogeologic unit or interval over which the wells are screened. The wells are screened in the shallow groundwater system within the Upper Continental Deposits, in the upper portion of the RGA, and in the lower portion of the RGA within the Lower Continental Deposits.

Tables 6-1 and 6-2 present the well construction information pertinent to data analysis for the Stage A and Stage B monitoring wells tested. Well construction details are important since well and sandpack diameter, screen length, and the height of the water column in the well determine the test method chosen and are used during the data analysis.

Wells in the Upper Continental Deposits are screened in various portions of the unit. The wells are screened over a very small area of the unit and hydraulic conductivities determined within these wells may not be representative of conditions occurring in other portions of this zone. The wells are screened in sandy layers within the unit, which may not be continuous or hydraulically connected to other portions of the unit.

Wells in the RGA are screened predominantly in the upper portion of the gravel unit, at varying depths, and are representative of the upper part of the aquifer.

METHODOLOGY

FIELD TESTING METHODS

Slug tests were performed on Stage A onsite wells from April 9 to 24, 1991 (Figure 6-1) and on Stage B wells from April 25 to May 3, 1991 (Figure 6-2). Rising head recovery tests were performed using either a pneumatic displacement device or a teflon® and stainless steel displacement cylinder. Tables 6-1 and 6-2 indicate which test was used on each well.

Table 6-1
Stage A Well Construction Details
PGDP Phase II Site Investigation
(page 1 of 2)

Well	Aquifer	Lithology	Location	Well Riser I.D.	Sanded Interval[a]	Screen Length	Top of Screen Elevation[a]	Water Elevation[a]	Test Method
MW-155	Lower RGA	LCD	C-400 Area	2 in.	82-95	5 ft	87	39.0	PDD
MW-156	Upper RGA	LCD	C-400 Area	2 in.	61-75	7 ft	63	47.5	PDD
MW-157	SGS	UCD	C-400 Area	2 in.	25-37	5 ft	30	29.1	DC
MW-158	Lower RGA	LCD	WMU-91	2 in.	97-110	6 ft	102	39.2	PDD
MW-159	Upper RGA	LCD	WMU-91	2 in.	58-70	5 ft	63	40.0	PDD
MW-160	SGS	UCD	WMU-91	2 in.	15-28	5 ft	20	5.4	PDD
MW-161	Upper RGA	LCD	WMU-1	2 in.	73-85	5 ft	78	39.8	PDD
MW-162	SGS	UCD	WMU-1	2 in.	14-25	5 ft	18	8.8	PDD
MW-163	Upper RGA	LCD	East Plant	2 in.	87-100	5 ft	94	51.5	PDD
MW-164	SGS	UCD	East Plant	2 in.	37-48	5 ft	42	40.2	DC
MW-165	Upper RGA	LCD	North Plant	2 in.	57.5-70	5 ft	63	46.4	PDD
MW-166	SGS	UCD	North Plant	2 in.	28-40	5 ft	33	32.9	DC
MW-167	SGS	UCD	10th St./Va. Ave.	2 in.	16-28	5 ft	21	5.7	PDD
MW-168	Upper RGA	LCD	10th st./Va. Ave.	2 in.	58-70	5 ft	63	43.0	PDD
MW-169	Upper RGA	LCD	001 Ditch	2 in.	59-70	5 ft	65	39.0	PDD
MW-170	SGS	UCD	001 Ditch	2 in.	20-30	5 ft	25	5.2	PDD
MW-175	Upper RGA	LCD	C-400 Area	2 in.	68-80	5 ft	75	47.1	PDD

Table 6-1
Stage A Well Construction Details
PGDP Phase II Site Investigation
(page 2 of 2)

Well	Aquifer	Lithology	Location	Well Riser I.D.	Sanded Interval[a]	Screen Length	Top of Screen Elevation[a]	Water Elevation[a]	Test Method
MW-177	SGS	UCD	C-400 Area	2 in.	34.5-46.5	5 ft	39.5	41.2	DC
MW-178	Upper RGA	LCD	C-400 Area	2 in.	56-69	5 ft	62.5	44.7	PDD
MW-188	Upper RGA	LCD	WMU-1	2 in.	59.5-75	5 ft	70	40.2	PDD
MW-189	SGS	UCD	WMU-1	2 in.	16.5-28.5	5 ft	22.5	15.7	PDD
MW-190	SGS	UCD	WMU-5	2 in.	13-25	5 ft	17.5	2.50	PDD

NOTES:

RGA - Regional Gravel Aquifer
SGS - Shallow Groundwater System
LCD - Lower Continental Deposits
UCD - Upper Continental Deposits
DC - Displacement Cylinder
PDD - Pneumatic Displacement Device
[a]Depth Below Ground Surface (feet)

Table 6-2
Stage B Well Construction Details
PGDP Phase II Site Investigation
(page 1 of 2)

Well	Aquifer	Lithology	Location	Well Riser I.D.	Sanded Interval[a]	Screen Length	Top of Screen Elevation[a]	Water Elevation[a]	Test Method
MW-191	Upper RGA	LCD	Ogden Landing Rd./L. Bayou Cr.	2 in.	50-61	5 ft	55	25.9	PDD
MW-192	SGS	UCD	Ogden Landing Rd./L. Bayou Cr.	2 in.	33-50	5 ft	38	25.5	PDD
MW-193	Upper RGA	LCD	Ogden Landing Rd.	2 in.	58-70	5 ft	63	33.7	PDD
MW-194	Upper RGA	LCD	Big Bayou Creek/NW Plant	2 in.	42-53	5 ft	46.9	21.3	PDD
MW-195	SGS	UCD	Big Bayou Creek/NW Plant	2 in.	5-17	5 ft	6	7.71	DC
MW-196	SGS	UCD	Entrance Rd & Acid Rd	2 in.	16.9-30	5 ft	21.9	6.0	PDD
MW-197	Upper RGA	LCD	KOW Rd M-6/N. Plant	2 in.	53-65	5 ft	58	35.0	PDD
MW-198	SGS	UCD	KOW Rd M-6/N. Plant	2 in.	13-25	5 ft	18	14.4	DC
MW-200	Upper RGA	LCD	KOW Rd M-9/N. Plant	2 in.	69-80	5 ft	74	46.2	PDD
MW-201	Upper RGA	LCD	Boldry School Rd.	2 in.	56.5-70	5 ft	62.5	35.2	PDD

Table 6-2 Stage B Well Construction Details PGDP Phase II Site Investigation (page 2 of 2)									
Well	**Aquifer**	**Lithology**	**Location**	**Well Riser I.D.**	**Sanded Interval[a]**	**Screen Length**	**Top of Screen Elevation[a]**	**Water Elevation[a]**	**Test Method**
MW-202	Upper RGA	LCD	KOW Rd. M-7	2 in.	72-85	5 ft	77	40.0	PDD
MW-203	Upper RGA	LCD	Onsite/N. of 720 Bldg.	2 in.	68-80	5 ft	71	44.9	PDD
MW-204	SGS	UCD	Onsite/N. of 720 Bldg.	2 in.	45.9-55	5 ft	49.4	37.5	PDD

NOTES:

RGA - Regional Gravel Aquifer
SGS - Shallow Groundwater System
LCD - Lower Continental Deposits
UCD - Upper Continental Deposits
DC - Displacement Cylinder
PDD - Pneumatic Displacement Device
[a]Depth Below Ground Surface (feet)

CH2M HILL personnel involved in the field effort were Mary Kate Dwyer (NJO), Annette Mario (PHL), and Elena Pomar (DFB). Eberline personnel providing health and safety monitoring of fieldwork were Bob Moya and John Taylor.

The test data were collected in digital form using a Campbell 21X datalogger linked to Druck pressure transducers. The tests were performed using one of two methods: a pneumatic displacement method, or a displacement cylinder method. Both methods were not performed on any one well since these methods were used only to suppress the water column in the well. The actual test began when the water column started to rise toward recovery, so test results would be similar regardless of which method was used. A bailer was not needed to conduct any of the tests since enough water was present in the wells to use the displacement cylinder.

Pneumatic Displacement Method

The pneumatic displacement apparatus developed to suppress the water column in a well consisted of a packer assembly, fittings for the transducers and pressure application, and a pressure-release valve. When the packer was lowered into the upper portion of the monitoring well, clamped in place and inflated, it provided a seal between the apparatus and the inside of the well. Two fittings were provided for inserting transducers. One transducer was lowered down through the packer and placed approximately 10 ft below the water surface in the well, and remained at that depth throughout the test. The other transducer was inserted into the side of the packer to measure the induced gas pressure (above the water surface during the test). A third fitting allowed gas to be introduced to pressurize the well. Compressed bottled nitrogen was fed through a regulator and into the apparatus. The pressure could be released quickly through a ball valve to start each test.

Twenty-nine wells were tested using the pneumatic displacement method. The test was generally repeated a second time in each well to evaluate the repeatability of the data. Each test was performed as follows. After the test apparatus was installed in the well, the packer was inflated and the well pressurized. The datalogger was programmed to display the pressure measured by the submersed transducer (T1) (ft of water), the gas pressure measured by the transducer (T2), and the difference between the two (T1-T2). The difference equalled the height of the water column (ft) above the submerged transducer. The gas pressure was regulated at a predetermined value. The water levels were routinely suppressed approximately 7 ft for the first and second tests, respectively. Wells with a very rapid response were tested a third time since the test duration was so short. Wells with a slow response were suppressed as far as possible (typically 3 to 5 ft), and were only tested twice. Only one test was performed on extremely slow wells. As the gas pressure was applied, the water level in the well declined to the desired level, displacing a slug of water from the well. Tests were begun after allowing for equilibration between the well and the geologic formation. The length of time allowed for equilibrium was variable, but the test was ready to start when the absolute change in water level did not vary by greater than approximately 0.01 ft in 1 minute. Wells in which the water level required an appreciable time to decline were given a correspondingly long time to re-equilibrate.

To start the test, the ball valve was opened to create an instantaneous release of pressure and the gas supply was shut off. When the datalogger detected a change in water level greater than a preset trigger value (0.1 ft), it began to record the elapsed time and the water level, yielding a record of water level as a function of time. Readings were taken at intervals of 0.5, 5, 60, or 300 sec, depending on the rate of recovery.

The datalogger program used was VHEAD 3-1 and was developed by CH2M HILL. It measures water levels and elapsed time during rising head tests. Generally, a test was ended after the water level recovered to approximately 90 percent of the original value.

The data held in the datalogger were transferred to floppy disks for storage at the end of each day.

Displacement Cylinder Method

Wells which were screened at the water table or where the water table was less than 5 ft above the top of the screen were tested using a displacement cylinder. Six wells were tested using the displacement cylinder. The test was performed twice in two of the wells to verify repeatability of the data since recovery time was relatively rapid (less than 2 hours). The four other wells tested required a 24-hour period to recover to 80 or 90 percent of the static water level and were only tested once. Each rising head test using this method was performed as follows. A pressure transducer was lowered down through the water and placed at the bottom of the well. The submerged transducer measured the pressure of the water column above it. The datalogger converted the measured pressure (psi) to ft of water, which was used directly as the depth of water (ft) above the transducer. A 1-3/4-in. outside diameter teflon® cylinder was submerged, causing the water level to rise due to displacement. The cylinder was constructed in 2-ft segments, so that the length could be adjusted from 2 to 8 ft, depending on the height of water present in the well. In each case, the length of the cylinder used was slightly greater than the height of the water column to minimize wave effects when conducting the test.

When the water level equilibrated in the well, the cylinder was rapidly lifted out of the water column using a tripod and pulley assembly. The rapid change in water level triggered the datalogger, which recorded elapsed time and corresponding water levels. Tests continued until the water level recovered to within 80 to 90 percent of the initial static water level measurements.

DATA ANALYSIS METHODS

The time and hydraulic head data obtained from the datalogger was plotted using the Geraghty & Miller (1985), computer package (AQTESOLV) in two forms of semilog plot for each test. The first plot is a time drawdown plot with the drawdown plotted on the logarithmic scale. For the second plot, the time is plotted on a logarithmic scale and the y scale corresponds to H/H_0, where H is the head in the well at time t after the test begins and H_0 is the initial head in the well immediately upon slug extraction. The AQTESOLV package assumes the slug test is a falling head test. The tests performed were rising head tests, so the H/H_0 values approach zero as the test progresses, rather than one in a falling head test. The purpose of the plots is to evaluate the general conduct of the test, to identify whether the tested aquifer is confined or unconfined, and to confirm the method of analysis of the test.

The first semilogarithmic plot is consistent with the Bouwer and Rice (1976) method for determining hydraulic conductivity of an unconfined aquifer. The second plot is consistent with the Cooper et al (1967) method for analyzing slug tests in a confined aquifer. Only the plot that gives the best fit is used for aquifer analysis and is presented. In some cases subsequent tests provided good fits with the alternative method. In those cases, results of both methods are presented. In one case (MW-157, RHT2), neither method provided a good fit for the data set and a hydraulic conductivity could not be calculated for this test.

Bouwer and Rice Method

The Bouwer and Rice method was developed to analyze slug test data from partially penetrating and partially screened wells in unconfined aquifers. The method can also be used in confined aquifers if the well screen is some distance below the confining unit. In some cases this condition is not met, yet the curve match is superior to the Cooper method. This condition would tend to indicate that the aquifer is not confined. The method is applicable to any diameter and depth of borehole, provided that the dimensions of the system are covered by the range for which the geometry factor R_e has been worked out. Bouwer and Rice used analog analyses to evaluate R_e for various geometries. The results were expressed in terms of a dimensionless ratio $\ln(R_e/r_w)$

Where: R_e is the effective radial distance over which the vertical distance, y, between water level inside the well and static water table outside the well is dissipated.

r_w is the radial distance of the undisturbed portion of aquifer from the centerline

Bouwer and Rice developed a governing equation for the rise of water level in the well after a slug of water was suddenly removed. They integrated the equations and obtained the following expression for K:

$$K = r_c^2/2L_e \ln(R_e/r_w) 1/t \ln(y_0/y_t)$$

Where: y = the vertical distance between water level inside the well and static water table outside the well

y_0 = y at time zero; and y_t = y at time t

t = time

L_e = length of screened portion of the well

r_c = radius of casing

r_w = radius of well including gravel pack

Re = is the effective radial distance over which the vertical distance, y, between water level inside the well and static water table outside the well is dissipated

The method considers the effect of the gravel pack when calculating the equivalent value of r_c for the rising water level.

This method assumes:

- The equation used in this method is based on the Theim equation and therefore assumes steady-state conditions.
- The aquifer is unconfined, homogeneous, isotropic, and of uniform thickness.
- The aquifer potentiometric surface is initially horizontal.
- The pulse produced by the slug affects the aquifer over a certain distance R_e.
- A volume of water (V) is injected into or displaced from the well.

For more details on Bouwer and Rice method, see Bouwer (1976 and 1989).

Figure 6-3 presents an example of data from one of these tests analyzed with the Bouwer and Rice method.

Cooper-Bredehoeft-Papadopulos Method

The method was developed to analyze slug test data from wells screened in confined aquifers. This method estimates transmissivity and storativity using a curve-matching technique. Field data are plotted on semilog curves. The head/initial head (H/H_0) is plotted on the arithmetic scale and time on the logarithmic scale. The plot is then superimposed on a set of type-curves. A match line is selected for a "t" value corresponding to $Tt/r_c^2 = 1$. This "t" value is then used in the appropriate equation to solve for transmissivity. Storativity is obtained from the selected Alpha value and values of the casing radius and the well radius.

This method assumes:

- The aquifer has infinite areal extent.
- The aquifer is confined, homogeneous, isotropic, and of uniform thickness.
- The aquifer potentiometric surface is initially horizontal.

- Instantaneous injection or removal of water from the well occurs.
- Well storage is negligible.
- Well is fully penetrating.
- Flow to well is horizontal.
- Water is released instantaneously from storage with decline of hydraulic head.

This method also considers the effects of well bore storage.

Figure 6-4 presents an example data from one of the tests plotted over the Cooper- type curve.

Slug Test Data Analysis Computer Package AQTESOLV

The two methods for estimating hydraulic conductivity using slug test data can be analyzed with the aid of AQTESOLV. AQTESOLV combines statistical parameter estimation methods with graphical curve matching to analyze aquifer test data. AQTESOLV uses nonlinear least-squares parameter estimation procedures to estimate aquifer properties from aquifer tests. For slug test solutions, the methods available consist of the Bouwer and Rice method, which produces an estimate of hydraulic conductivity and values of the drawdown axis intercept, and the Cooper-Bredehoeft-Papadopulos method, which produces estimates of transmissivity (T) and storativity (S). A detailed description of AQTESOLV is found in Geraghty and Miller (1985).

Each set of test data was analyzed using methods developed by Bouwer and Rice and/or Cooper et al. Water level recordings and elapsed time were transferred from raw data sets into files adjusted for use with the computer program AQTESOLV.

Initially, calculation of hydraulic conductivity was based on the AQTESOLV estimates of aquifer coefficients. AQTESOLV adjusts aquifer coefficients to match the type curve to the time drawdown data. For the Bouwer and Rice method, the variance of the best-fit line compared to the data curve was evaluated. If the best-fit line varied greatly from points of the data set, a subset was created and evaluated over a shorter duration of the test. For tests of a short duration (0 to 250 sec), the entire data set was generally used to calculate hydraulic conductivity. For high values of K, most of the data points fell on or near the best-fit line. For tests of a long duration (1-24 hr), the subset of data evaluated occurred between 0 and 80 percent of static water level recovery. This range eliminated the noise in the data set due to the tailing off of the data as the water level asymptotically approaches static water level. When the double straight line effect was observed, the graphic cursor was used so that the hydraulic conductivity was estimated based on the second straight line. The first straight line portion of the curve is probably due to a more permeable zone around the well. It probably represents a gravel pack or a more developed aquifer zone around the well, which quickly released water to the well. Then, when the water level in the permeable zone around the well has drained to the level of the well, the flow to the well slows down and the data points form a less steep straight line. This is more indicative of flow from the undisturbed aquifer into the well. The value of hydraulic conductivity and the slope of the best-fit line are at the bottom of each graph (Attachments A and B). Slopes of the graphs may appear different based on the length of the test, the recovery response of the aquifer, and the degree to which the well recovered. Values of hydraulic conductivity for each well tested are presented in Table 6-3 and Table 6-4.

Transmissivity (T) was calculated using the following equation:

$$T=Kb$$

where:

T = transmissivity (gal/day/ft)
K = hydraulic conductivity from slug tests (gal/day/ft^2)
b = estimated saturated thickness (ft)

For each well, the average value of K used to calculate the transmissivity was obtained from the geometric means of representative tests from that well. The geometric mean is calculated by taking the nth root of the product of all the K values (n_1 x n_2 x n_3). Possible variations of K in adjacent unscreened portions of the aquifer were not considered in this analysis.

A test was considered to be representative of the well if a review of the graph revealed that the best-fit line contained a majority of the data points, the test was comparable to other tests performed with similar displacement on that well, and water levels had recovered to at least 80 percent of their original value. The method selection was not based on existing assumptions of the confined or unconfined nature of the aquifer. The method selected provided the best curve match. If the Cooper method provided the best match, the aquifer is probably confined at that location. Geometric means were calculated from representative tests to provide a geometric average hydraulic conductivity value for each well (Table 6-5). The average K value was used to calculate the transmissivity values presented in Table 6-5.

For wells in the shallow groundwater system, the estimated saturated thickness, b, was based on the depth from the water table to the bottom of the screen, assuming that the screen was seated in a clay unit that acts as a barrier to downward flow into the RGA.

In Phase II, only two of the wells installed (MW-155, MW-158) fully penetrated the RGA. The thickness of the RGA in the other wells was estimated based on information obtained from the boring log for each well cluster and on the isopach map for the Lower Continental Deposits from the Phase I Site Investigation Report (Figure 3-17).

DECONTAMINATION OF EQUIPMENT

Field equipment introduced into the wells was decontaminated between well locations and before leaving the site. Equipment included the packer system, transducers, displacement

Table 6-3
Hydraulic Conductivities for All Tests Conducted on Stage A Wells at PGDP
PGDP Phase II Site Investigation
(page 1 of 4)

Appendix A Fig No.	Well No., Test No.	K (cm/sec)	Data Analysis Method	Percent Recovery of Test	Total Displacement (ft)
SHALLOW GROUNDWATER SYSTEM					
A-1	MW157, RHT1	2.47×10^{-5}	Bouwer	100	3.20
	MW157, RHT2	Poor data		98	4.01
A-2	MW160, RHT1	5.41×10^{-6}	Bouwer	91	3.03
A-3	MW160, RHT2	8.45×10^{-5}	Bouwer	93	3.07
A-4	MW162, RHT1	4.30×10^{-5}	Cooper	99	4.00
A-5	MW162, RHT2	2.86×10^{-5}	Bouwer	96	4.00
A-6	MW164, RHT1	6.54×10^{-4}	Bouwer	80	3.38
A-7	MW166, RHT1	1.02×10^{-8}	Bouwer	88	2.28
A-8	MW167, RHT1	3.65×10^{-5}	Cooper	98	6.52
A-9	MW167, RHT2	3.64×10^{-5}	Cooper	97	6.36
A-10	MW170, RHT1	1.63×10^{-7}	Cooper	93	4.55
A-11	MW170, RHT2	9.93×10^{-5}	Bouwer	52	4.52
A-12	MW177, RHT1	2.81×10^{-4}	Bouwer	90	1.04
A-13	MW189, RHT1	4.27×10^{-5}	Bouwer	100	3.61
A-14	MW189, RHT2	4.27×10^{-5}	Bouwer	100	3.52
A-15	MW190, RHT1	1.16×10^{-5}	Cooper	96	5.03

Table 6-3
Hydraulic Conductivities for All Tests Conducted on Stage A Wells at PGDP
PGDP Phase II Site Investigation
(page 2 of 4)

Appendix A Fig No.	Well No., Test No.	K (cm/sec)	Data Analysis Method	Percent Recovery of Test	Total Displacement (ft)
A-16	MW190, RHT2	1.24×10^{-5}	Cooper	98	5.09
UPPER RGA					
A-17	MW156, RHT1	3.31×10^{-3}	Cooper	100	6.99
A-18	MW156, RHT2	3.20×10^{-3}	Cooper	100	7.03
A-19	MW156, RHT3	3.17×10^{-3}	Cooper	100	7.07
A-20	MW159, RHT1	3.95×10^{-3}	Bouwer	100	7.28
A-21	MW159, RHT2	4.00×10^{-3}	Bouwer	100	7.21
A-22	MW159, RHT3	3.93×10^{-3}	Bouwer	100	7.13
A-23	MW161, RHT1	2.61×10^{-2}	Bouwer	100	7.10
A-24	MW161, RHT2	2.63×10^{-2}	Bouwer	100	7.07
A-25	MW161, RHT3	1.76×10^{-2}	Bouwer	100	7.07
A-26	MW163, RHT1	4.76×10^{-2}	Bouwer	100	7.12
A-27	MW163, RHT2	3.20×10^{-2}	Bouwer	100	7.04
A-28	MW163, RHT3	6.13×10^{-3}	Bouwer	100	7.07
A-29	MW165, RHT1	7.83×10^{-3}	Cooper	100	7.22
A-30	MW165, RHT2	5.90×10^{-3}	Bouwer	100	7.14
A-31	MW165, RHT3	5.99×10^{-3}	Bouwer	100	7.14

Table 6-3
Hydraulic Conductivities for All Tests Conducted on Stage A Wells at PGDP
PGDP Phase II Site Investigation
(page 3 of 4)

Appendix A Fig No.	Well No., Test No.	K (cm/sec)	Data Analysis Method	Percent Recovery of Test	Total Displacement (ft)
A-32	MW168, RHT1	2.66×10^{-4}	Bouwer	100	7.18
A-33	MW168, RHT2	4.55×10^{-3}	Bouwer	100	7.34
A-34	MW169, RHT1	5.74×10^{-3}	Cooper	100	7.14
A-35	MW169, RHT2	7.12×10^{-3}	Cooper	100	7.24
A-36	MW169, RHT3	7.06×10^{-3}	Cooper	100	7.27
A-37	MW175, RHT1	3.12×10^{-2}	Bouwer	100	7.28
A-38	MW175, RHT2	3.09×10^{-2}	Bouwer	100	7.14
A-39	MW175, RHT3	2.95×10^{-2}	Bouwer	100	7.22
A-40	MW178, RHT1	2.15×10^{-2}	Bouwer	100	7.04
A-41	MW178, RHT2	2.06×10^{-2}	Bouwer	100	7.07
A-42	MW178, RHT3	1.89×10^{-2}	Bouwer	100	7.09
A-43	MW188, RHT1	5.16×10^{-2}	Bouwer	100	7.14
A-44	MW188, RHT2	3.08×10^{-2}	Bouwer	100	7.10
A-45	MW188, RHT3	4.56×10^{-2}	Bouwer	100	7.10
LOWER RGA					
A-46	MW155, RHT1	4.76×10^{-3}	Bouwer	100	6.98
A-47	MW155, RHT2	4.96×10^{-3}	Bouwer	100	7.11

Table 6-3
Hydraulic Conductivities for All Tests Conducted on Stage A Wells at PGDP
PGDP Phase II Site Investigation
(page 4 of 4)

Appendix A Fig No.	Well No., Test No.	K (cm/sec)	Data Analysis Method	Percent Recovery of Test	Total Displacement (ft)
A-48	MW155, RHT3	3.53×10^{-3}	Bouwer	100	7.05
A-49	MW158, RHT1	2.25×10^{-4}	Bouwer	100	7.18
A-50	MW158, RHT2	2.16×10^{-4}	Bouwer	97	7.12

Table 6-4
Hydraulic Conductivities for All Tests Conducted on Stage B Wells at PGDP
PGDP Phase II Site Investigation
(page 1 of 2)

Appendix B Fig No.	Well No., Test No.	K (cm/sec)	Data Analysis Method	Percent Recovery of Test	Total Displacement (ft)
SHALLOW GROUNDWATER SYSTEM					
B-1	MW192, RHT1	1.95×10^{-5}	Cooper	97	5.30
B-2	MW192, RHT2	3.75×10^{-5}	Bouwer	90	5.09
B-3	MW195, RHT1	6.31×10^{-4}	Bouwer	98	2.14
B-4	MW195, RHT2	6.93×10^{-4}	Bouwer	100	2.77
B-5	MW196, RHT1	1.06×10^{-4}	Bouwer	100	4.27
B-6	MW196, RHT2	5.56×10^{-5}	Cooper	91	4.55
B-7	MW198, RHT1	7.45×10^{-7}	Bouwer	92	5.00
B-8	MW204, RHT1	3.01×10^{-5}	Cooper	92	3.81
B-9	MW204, RHT2	3.78×10^{-5}	Cooper	92	4.61
UPPER RGA					
B-10	MW191, RHT1	2.17×10^{-2}	Bouwer	100	7.05
B-11	MW191, RHT2	1.66×10^{-2}	Cooper	100	7.07
B-12	MW191, RHT3	3.02×10^{-2}	Bouwer	100	7.06
B-13	MW193, RHT1	8.61×10^{-3}	Cooper	100	7.14
B-14	MW193, RHT2	3.77×10^{-3}	Cooper	100	7.11

Table 6-4 Hydraulic Conductivities for All Tests Conducted on Stage B Wells at PGDP PGDP Phase II Site Investigation (page 2 of 2)					
Appendix B Fig No.	**Well No., Test No.**	**K (cm/sec)**	**Data Analysis Method**	**Percent Recovery of Test**	**Total Displacement (ft)**
B-15	MW193, RHT3	4.11×10^{-3}	Cooper	100	7.14
B-16	MW194, RHT1	1.51×10^{-2}	Bouwer	99	10.28
B-17	MW194, RHT2	1.67×10^{-2}	Bouwer	100	6.96
B-18	MW194, RHT3	1.70×10^{-2}	Bouwer	100	7.03
B-19	MW197, RHT1	2.13×10^{-4}	Bouwer	100	7.11
B-20	MW197, RHT2	2.24×10^{-4}	Bouwer	100	7.04
B-21	MW201, RHT1	3.70×10^{-5}	Bouwer	100	6.08
B-22	MW201, RHT2	3.26×10^{-5}	Bouwer	97	6.00
UPPER RGA					
B-23	MW200, RHT1	5.81×10^{-3}	Bouwer	100	7.07
B-24	MW200, RHT2	5.65×10^{-3}	Bouwer	100	7.03
B-25	MW200, RHT3	4.08×10^{-3}	Cooper	100	7.08
B-26	MW202, RHT1	1.43×10^{-4}	Bouwer	100	7.04
B-27	MW202, RHT2	1.38×10^{-4}	Bouwer	97	7.01
B-28	MW203, RHT1	2.39×10^{-4}	Bouwer	99	7.05
B-29	MW203, RHT2	1.95×10^{-4}	Bouwer	94	7.02

Table 6-5
Geometric Mean of Hydraulic Conductivities and Estimated Transmissivities of Stage A and B Wells at PGDP
PGDP Phase II Site Investigation
(page 1 of 2)

Well No.	Geometric Average K (cm/sec)	K (gal/day/ft^2)	b (ft)	T (gal/day/ft)
Stage A Wells				
Shallow Groundwater System				
MW157	2.47×10^{-5}	5.23×10^{-1}	8.5	4.45
MW160	2.1×10^{-5}	4.53×10^{-1}	21.5	9.7
MW162	3.5×10^{-5}	7.44×10^{-1}	16	11.9
MW164	6.54×10^{-4}	13.87	8.5	118
MW166	1.02×10^{-8}	2.16×10^{-4}	7.5	0.0016
MW167	3.6×10^{-5}	7.73×10^{-3}	22	17.0
MW170	4.00×10^{-6}	8.53×10^{-2}	25	2.13
MW177	2.81×10^{-4}	5.96	7	41.7
MW189	4.2×10^{-5}	9.06×10^{-1}	13	11.8
MW190	1.2×10^{-5}	2.55×10^{-1}	22.5	5.74
Upper RGA				
MW156	3.23×10^{-3}	68.4	42	2,872
MW159	3.96×10^{-3}	83.99	48	4,032
MW161	2.29×10^{-2}	486.4	48	23,346
MW163	2.11×10^{-2}	446.8	25	11,169
MW165	6.52×10^{-3}	138.2	40	5,526
MW168	1.10×10^{-3}	23.33	20	466.6
MW169	6.61×10^{-3}	140.1	20	2,801
MW175	3.05×10^{-2}	647.5	42	27,195
MW178	2.03×10^{-2}	430.6	40	17,222
MW188	4.17×10^{-2}	884.2	48	42,442
Lower RGA				
MW155	4.37×10^{-3}	92.66	42	3,892
MW158	2.20×10^{-4}	4.67	48	224.3

Table 6-5
Geometric Mean of Hydraulic Conductivities and Estimated Transmissivities of Stage A and B Wells at PGDP
PGDP Phase II Site Investigation
(page 2 of 2)

Well No.	Geometric Average K (cm/sec)	K (gal/day/ft^2)	b (ft)	T (gal/day/ft)
Stage B Wells				
Shallow Groundwater System				
MW192	2.70×10^{-5}	5.74×10^{-1}	24.5	14.06
MW195	6.61×10^{-4}	14.02	9.5	133.2
MW196	7.67×10^{-5}	1.63	25	40.75
MW198	7.45×10^{-7}	1.57×10^{-2}	7.5	0.118
MW204	3.37×10^{-5}	7.16×10^{-1}	18.5	13.24
Upper RGA				
MW191	2.21×10^{-2}	469.9	30	14,087
MW193	5.11×10^{-3}	108.4	30	3,253
MW194	1.62×10^{-2}	344.5	40	13,780
MW197	2.18×10^{-4}	4.631	25	115.8
MW200	5.12×10^{-3}	108.5	25	2,712
MW201	3.40×10^{-5}	7.37×10^{-1}	30	22.11
MW202	1.40×10^{-4}	2.98	20	59.52
MW203	2.15×10^{-4}	4.58	40	183.1

cylinder, and water level indicators. Procedures followed for decontamination of equipment and materials before use were in accordance with Method ESP-900 (Martin Marietta Energy Systems, 1988).

Prior to departure from PGDP, all equipment used in the field was decontaminated. Wipe samples were collected and analyzed for transferable radiological contamination before release from the site for unrestricted use.

TEST RESULTS

As discussed earlier, the data from each slug test was plotted according to both the Cooper et al method and the Bouwer and Rice method to identify if the tested aquifer is confined or unconfined. Generally slug test data that are consistent with the Cooper method are considered to represent a confined aquifer, and data that are consistent with the Bouwer and Rice method represent an unconfined aquifer.

Slug tests that were consistent with confined aquifer behavior were analyzed using the Cooper et al method, while the ones that were not were analyzed using the Bouwer and Rice method. Some of the tests that were analyzed using the Bouwer and Rice method exhibited a double straight line. The first part is straight and steep and the second one is also straight but less steep. The first straight line portion of the curve is probably due to a more permeable zone around the well. It probably represents a gravel pack or a more developed aquifer area immediately around the well which quickly releases the water to the well. Then, when the water level in the permeable zone around the well has drained to the level of the well, the flow to the well slows down and the data points form a less steep straight line. This second line is more indicative of the flow from the undisturbed aquifer into the well. Therefore, the second straight line of plots, resulting from each unconfined slug test, was used to estimate the hydraulic conductivity of the aquifer.

The plots of the data points showing the best-fit line for each data set are presented in the graphs in Attachments A and B. Tables 6-3 and 6-4 present a summary of the results of this analysis and the calculated values of hydraulic conductivity for each well tested. Table 6-5 presents the geometric average hydraulic conductivity for each well and the calculated transmissivities for the portion of the aquifer tested.

Rising head tests were conducted on 15 wells screened within the shallow groundwater system (MW-157, MW-160, MW-162, MW-164, MW-166, MW-167, MW-170, MW-177, MW-189, MW-190, MW-192, MW-195, MW-196, MW-198, MW-204). Only one test was conducted on MW-164, MW-166, MW-177, and MW-198, since the wells took a long time to recover. The range of hydraulic conductivity in the shallow groundwater system was 1.0 x 10^{-8} cm/sec to 6.9 x 10^{-4} cm/sec. The geometric mean of these 15 average K values was 2.1 x 10^{-5} cm/sec. Estimates of transmissivity ranged from 0.0016 to 133 gal/day/ft.

Eighteen wells were tested in the upper RGA (MW-156, MW-159, MW-161, MW-163, MW-165, MW-168, MW-169, MW-175, MW-178, MW-188, MW-191, MW-193, MW-194, MW-197, MW-200, MW-201, MW-202, MW-203). The range of hydraulic conductivity in the upper RGA was 4.2×10^{-2} cm/sec to 3.4×10^{-5} cm/sec. The geometric mean of these 18 average values was 2.9×10^{-3} cm/sec. Estimated transmissivity ranged from 22 to 42,400 gal/day/ft.

Two wells were tested in the lower RGA (MW-155, MW-158). The range of hydraulic conductivity in the lower RGA was 4.4×10^{-3} cm/sec to 2.2×10^{-4} cm/sec. The geometric mean of these two values is 9.8×10^{-4} cm/sec. Estimates of transmissivity ranged from 224 to 3,892 gal/day/ft.

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Geraghty and Miller Modeling Group. *Aquifer Test Solver.* AQTESOLV. Preston White Drive, Suite 301, Reston, VA 22091. 1985.

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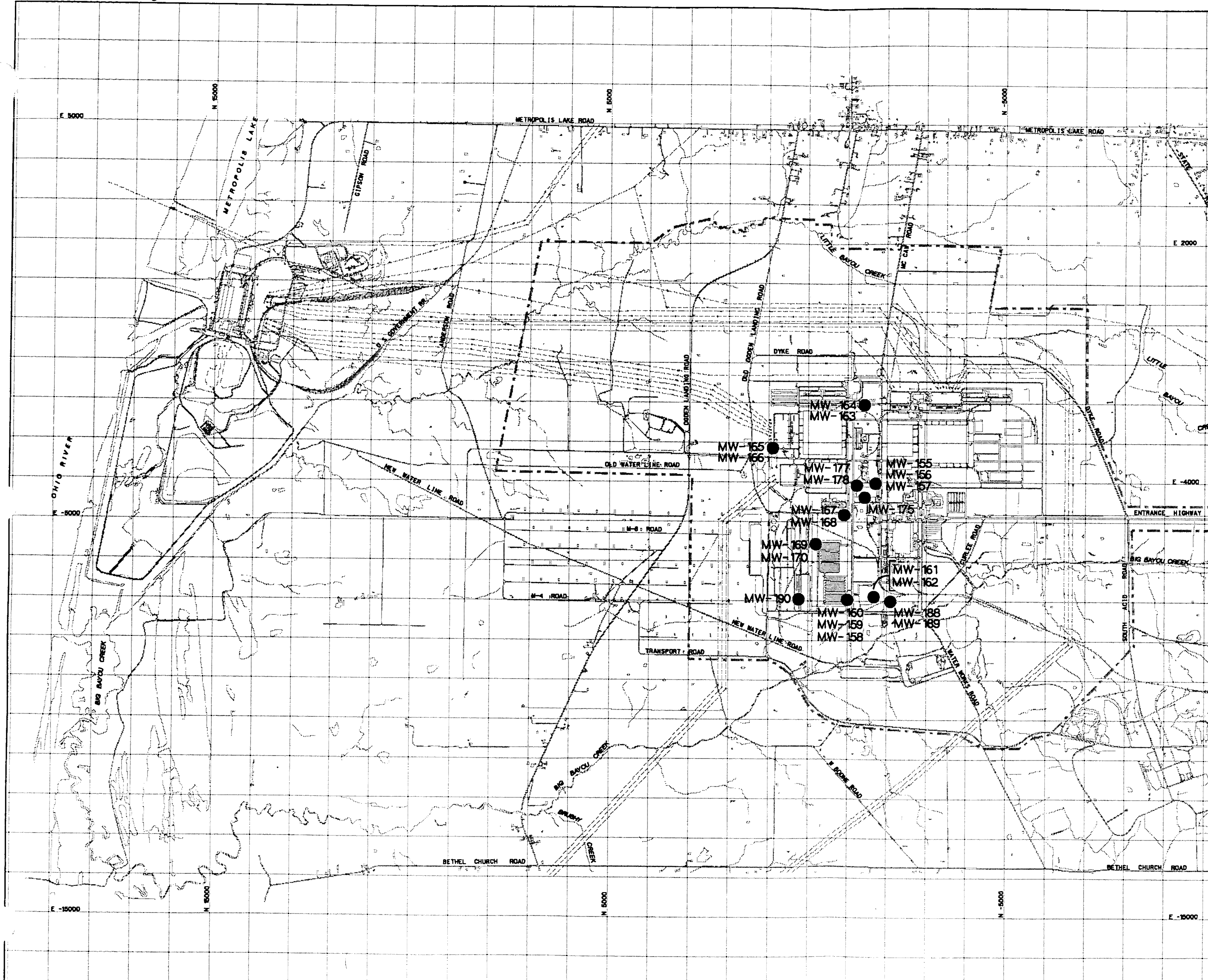

REVIEWED FOR CLASSIFICATION

WJ 7/9/03

Initials Date

UNCLASSIFIED

LEGEND

● MW-160 PHASE II MONITORING WELLS

PLANT NORTH

20°

TRUE NORTH

0 1250 2500 3750

SCALE 1"= 2500'

Figure 6-1

STAGE A WELL LOCATIONS FOR SLUG TESTS

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY.

PHASE II SITE INVESTIGATION

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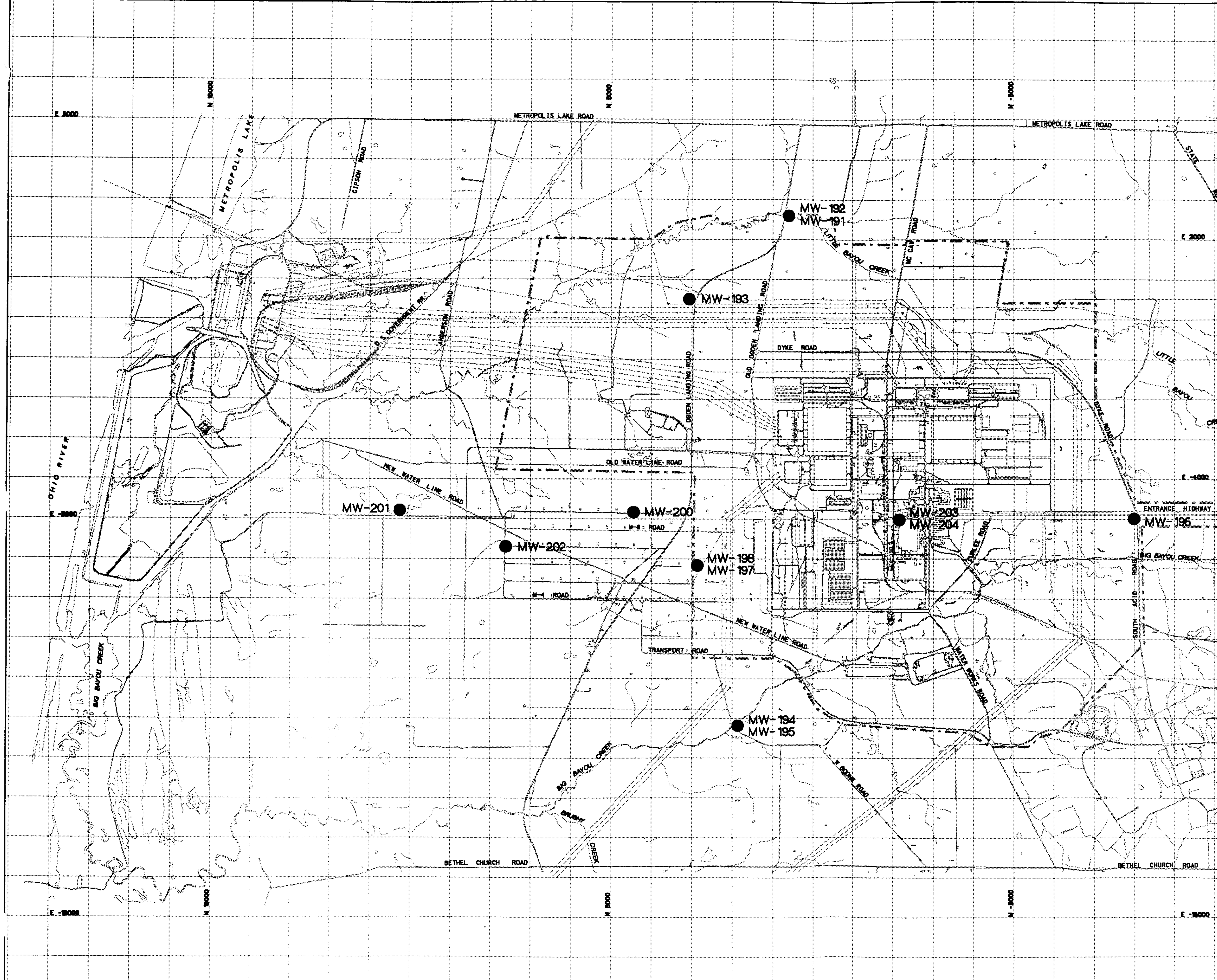

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UNCLASSIFIED

Figure 6-2
STAGE B WELL LOCATIONS FOR SLUG TESTS
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

Attachment A
STAGE A WELLS

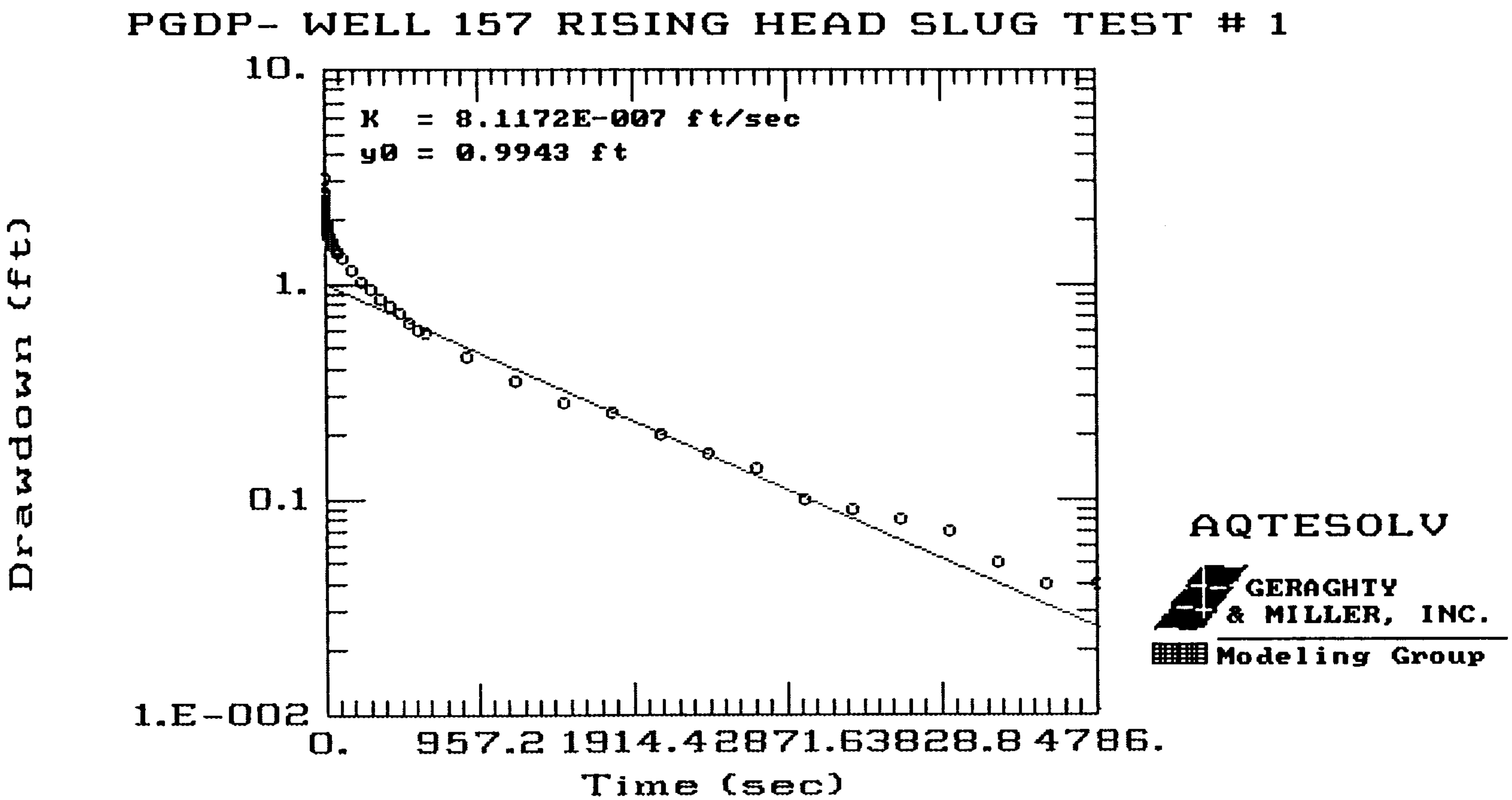

PGDP- WELL 157 RISING HEAD SLUG TEST # 1
K = 8.1172E-007 ft/sec
y0 = 0.9943 ft
10.
1.
0.1
1.E-002
0.
957.2
1914.4
2871.6
3828.8
4786.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-1

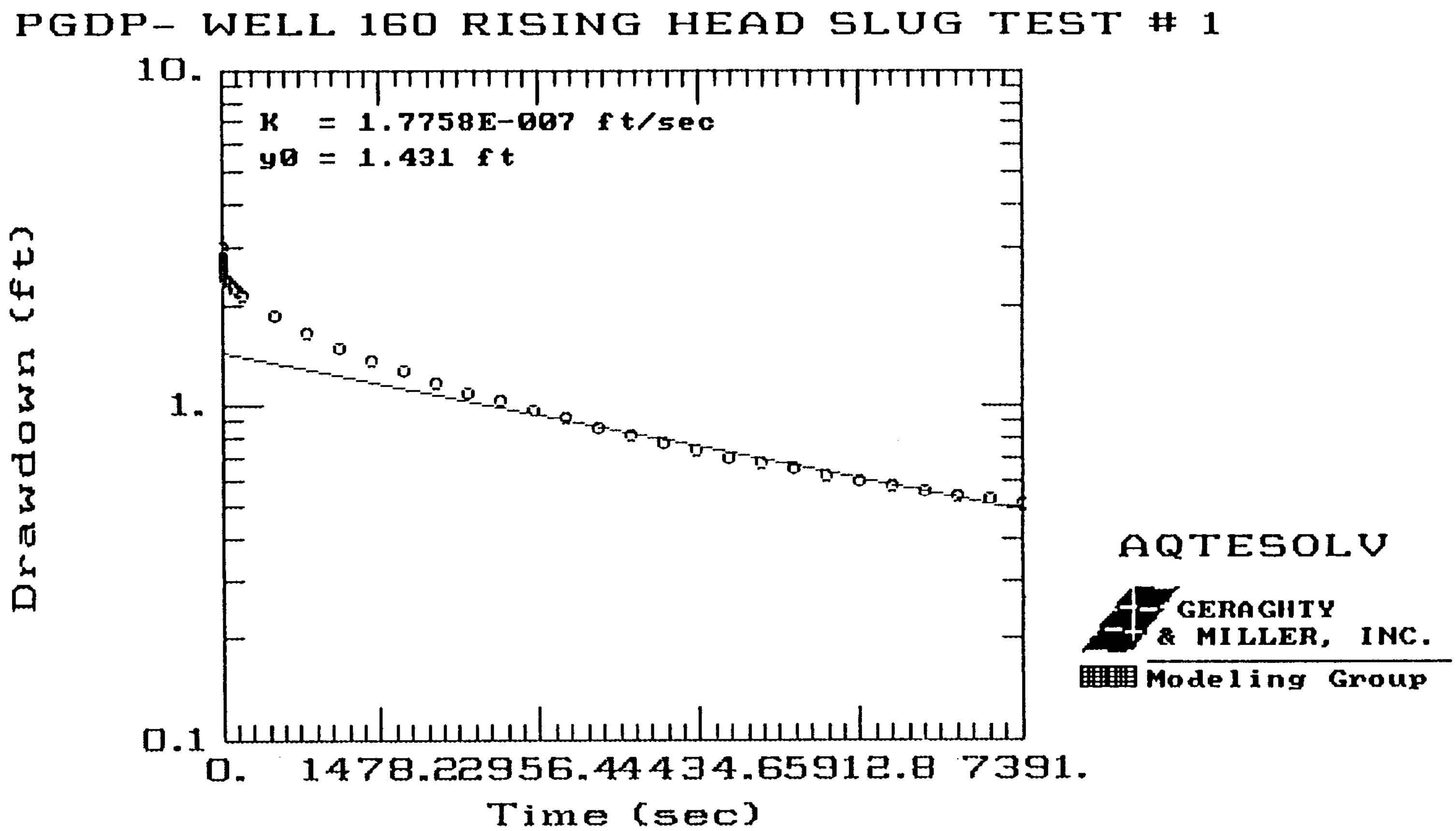

PGDP- WELL 160 RISING HEAD SLUG TEST # 1
K = 1.7758E-007 ft/sec
y0 = 1.431 ft
10.
1.
0.1
Drawdown (ft)
0. 1478.22956.44434.65912.8 7391.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-2

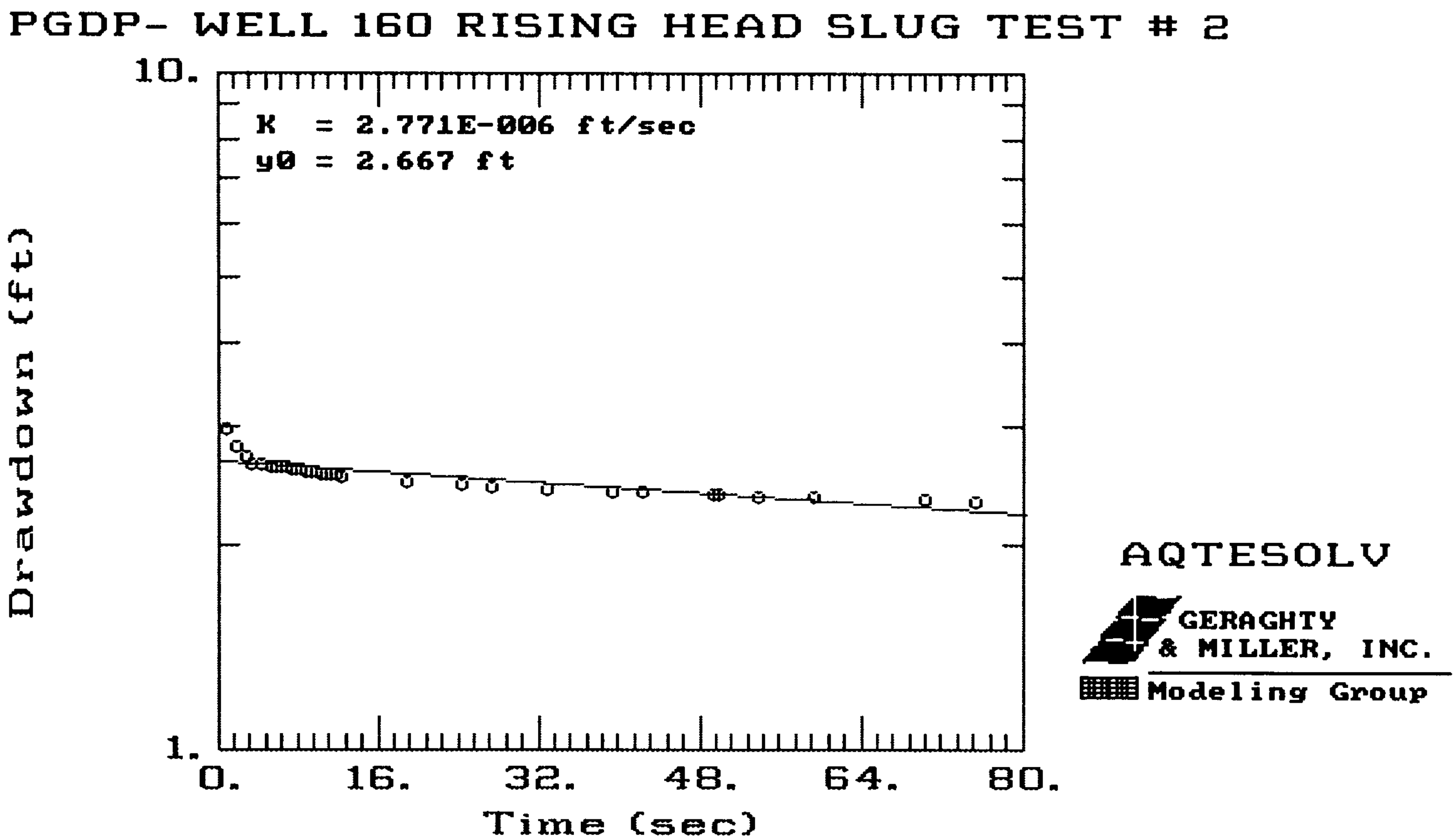

PGDP- WELL 160 RISING HEAD SLUG TEST # 2
K = 2.771E-006 ft/sec
y0 = 2.667 ft
10.
1.
0.
16.
32.
48.
64.
80.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-3

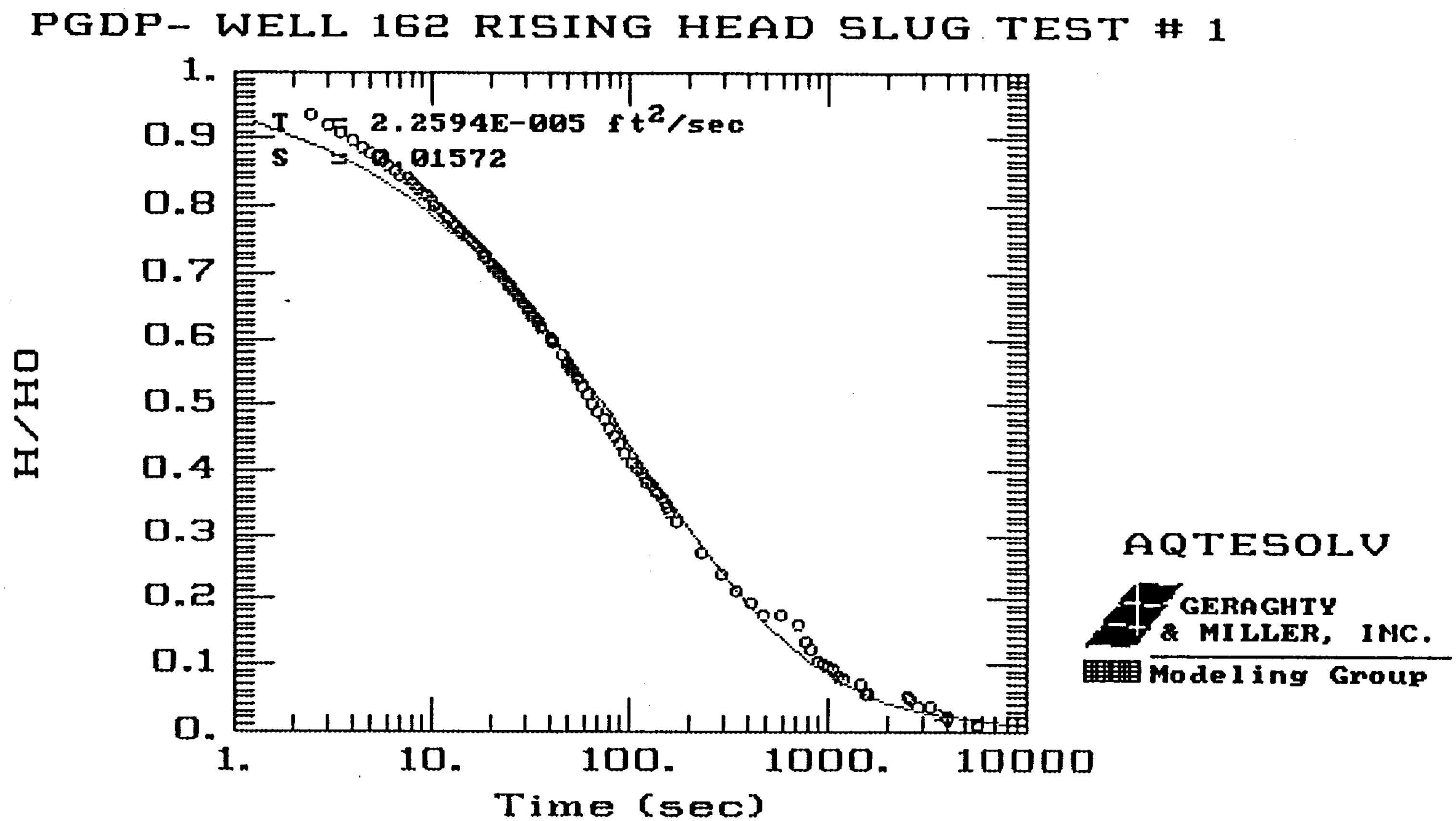

PGDP- WELL 162 RISING HEAD SLUG TEST # 1
T = 2.2594E-005 ft2/sec
S = 0.01572
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
1.
10.
100.
1000.
10000
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-4

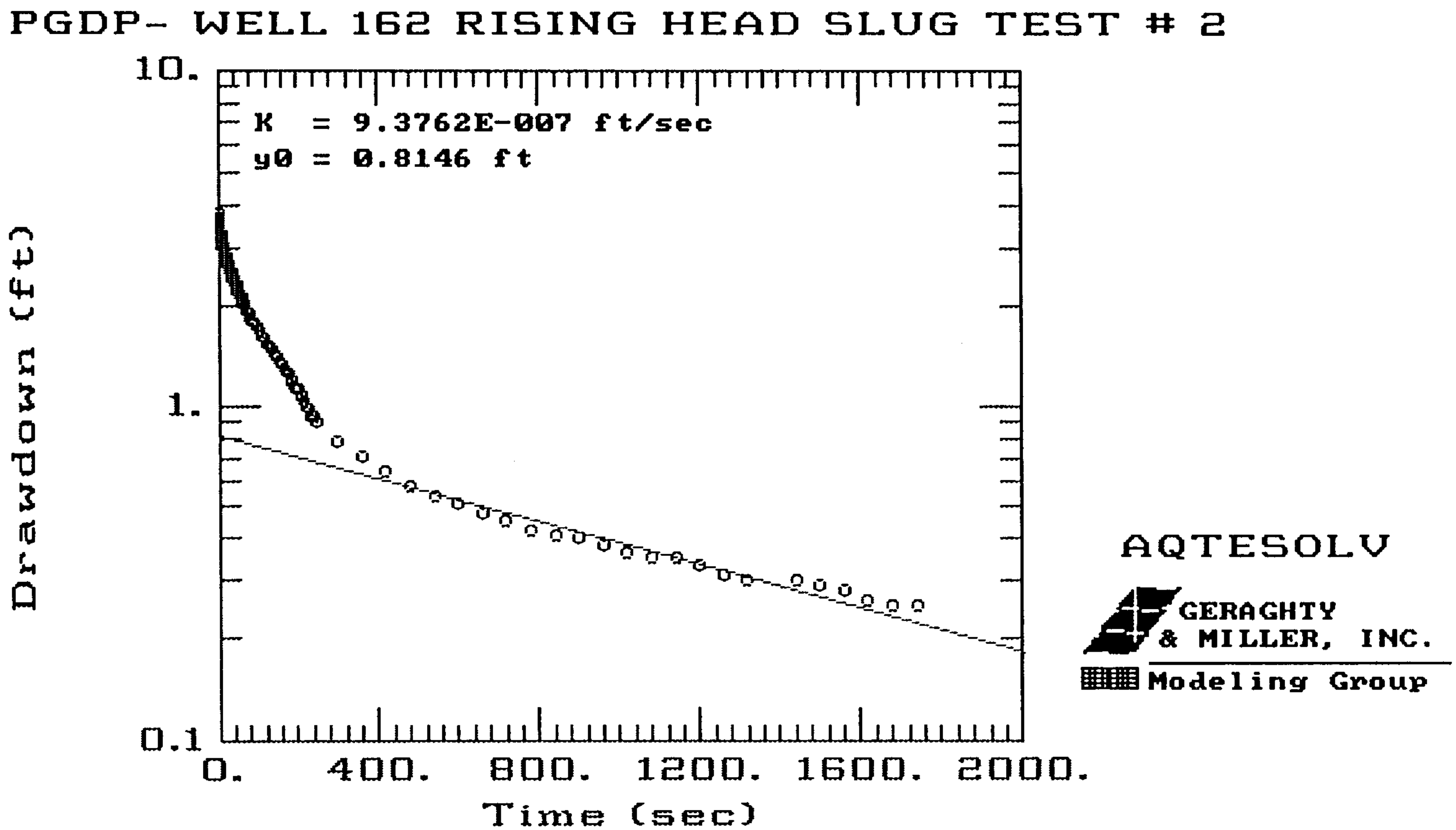

PGDP- WELL 162 RISING HEAD SLUG TEST # 2
K = 9.3762E-007 ft/sec
y0 = 0.8146 ft
Drawdown (ft)
Time (sec)
10.
1.
0.1
0.
400.
800.
1200.
1600.
2000.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-5

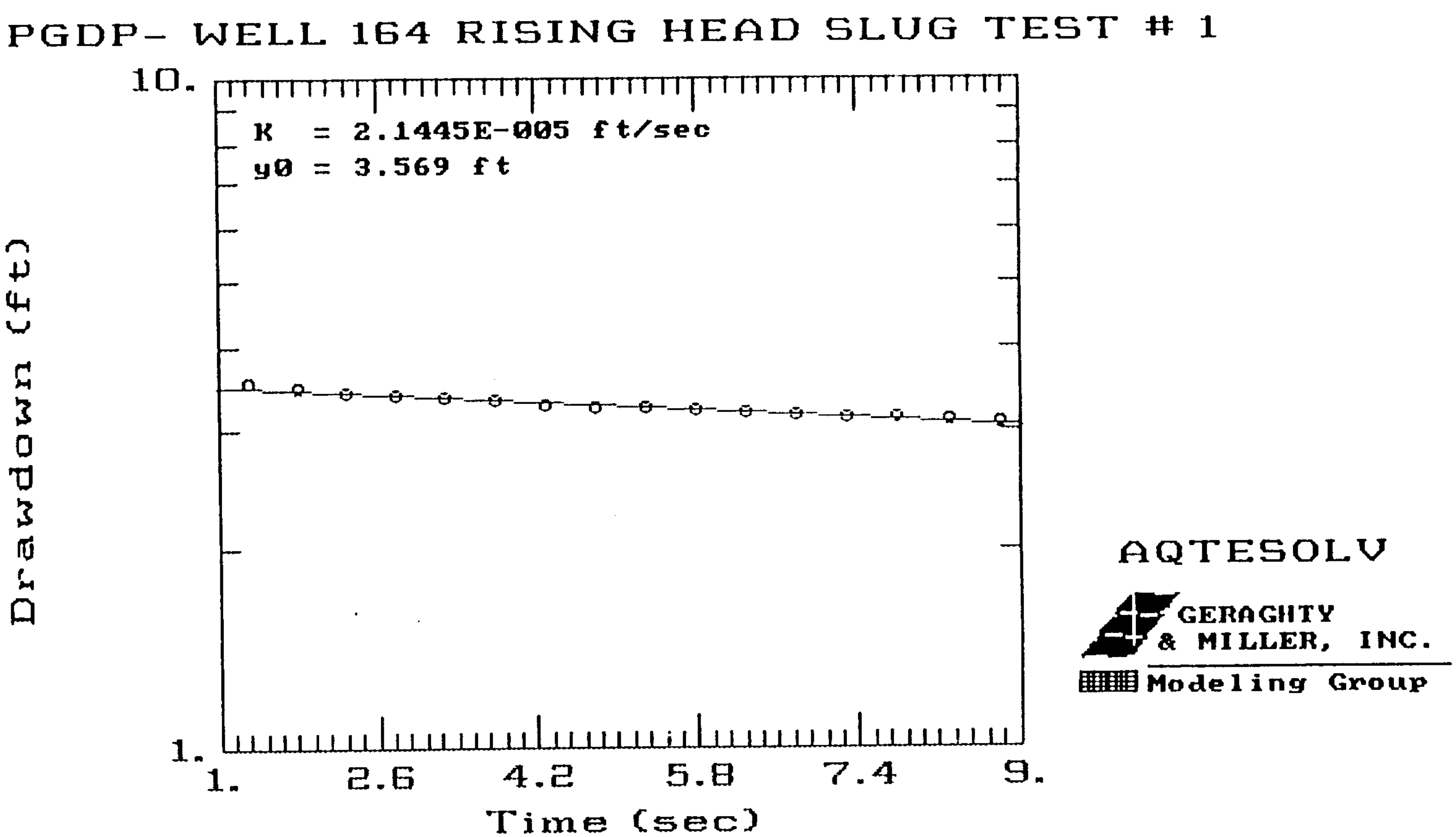

PGDP- WELL 164 RISING HEAD SLUG TEST # 1
K = 2.1445E-005 ft/sec
y0 = 3.569 ft
Drawdown (ft)
Time (sec)
10.
1.
1.
2.6
4.2
5.8
7.4
9.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-6

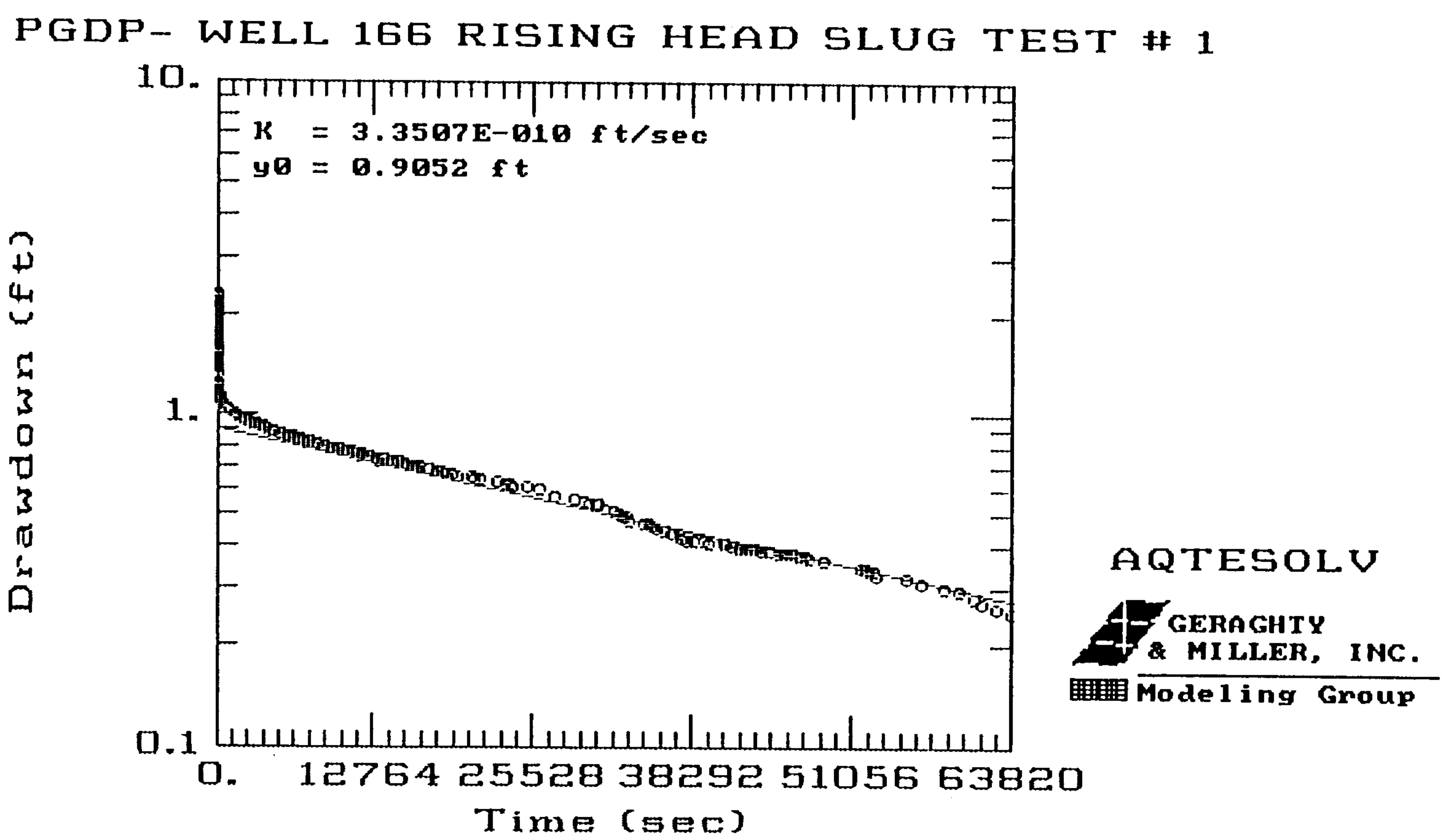

PGDP- WELL 166 RISING HEAD SLUG TEST # 1
K = 3.3507E-010 ft/sec
y0 = 0.9052 ft
10.
1.
0.1
Drawdown (ft)
0.
12764
25528
38292
51056
63820
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-7

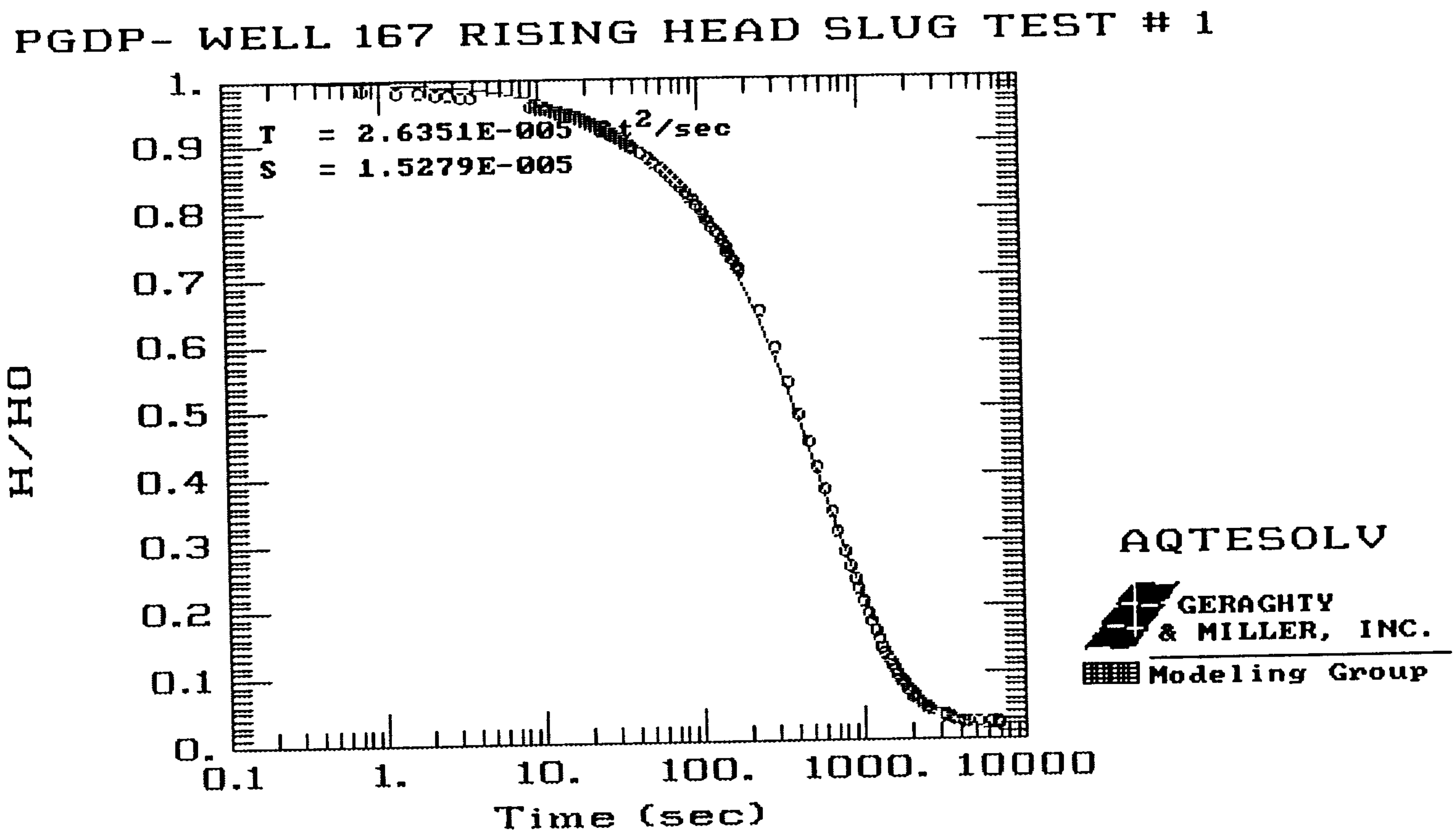
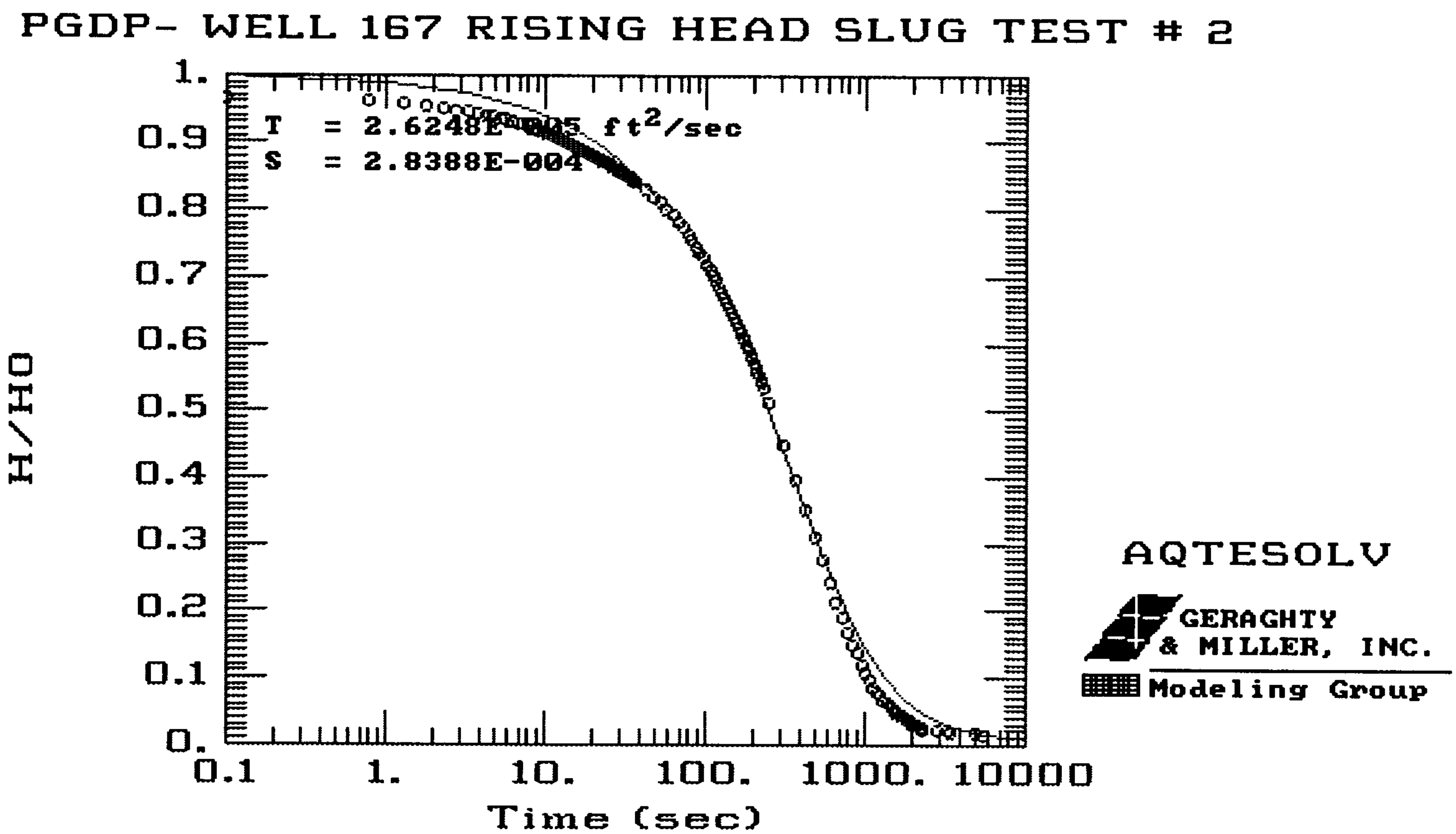

PGDP- WELL 167 RISING HEAD SLUG TEST # 1
T = 2.6351E-005 ft^2/sec
S = 1.5279E-005
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
10000
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-8



PGDP- WELL 167 RISING HEAD SLUG TEST # 2
T = 2.6248E-005 ft²/sec
S = 2.8388E-004
H/HO
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-9

PGDP- WELL 170 RISING HEAD SLUG TEST # 1

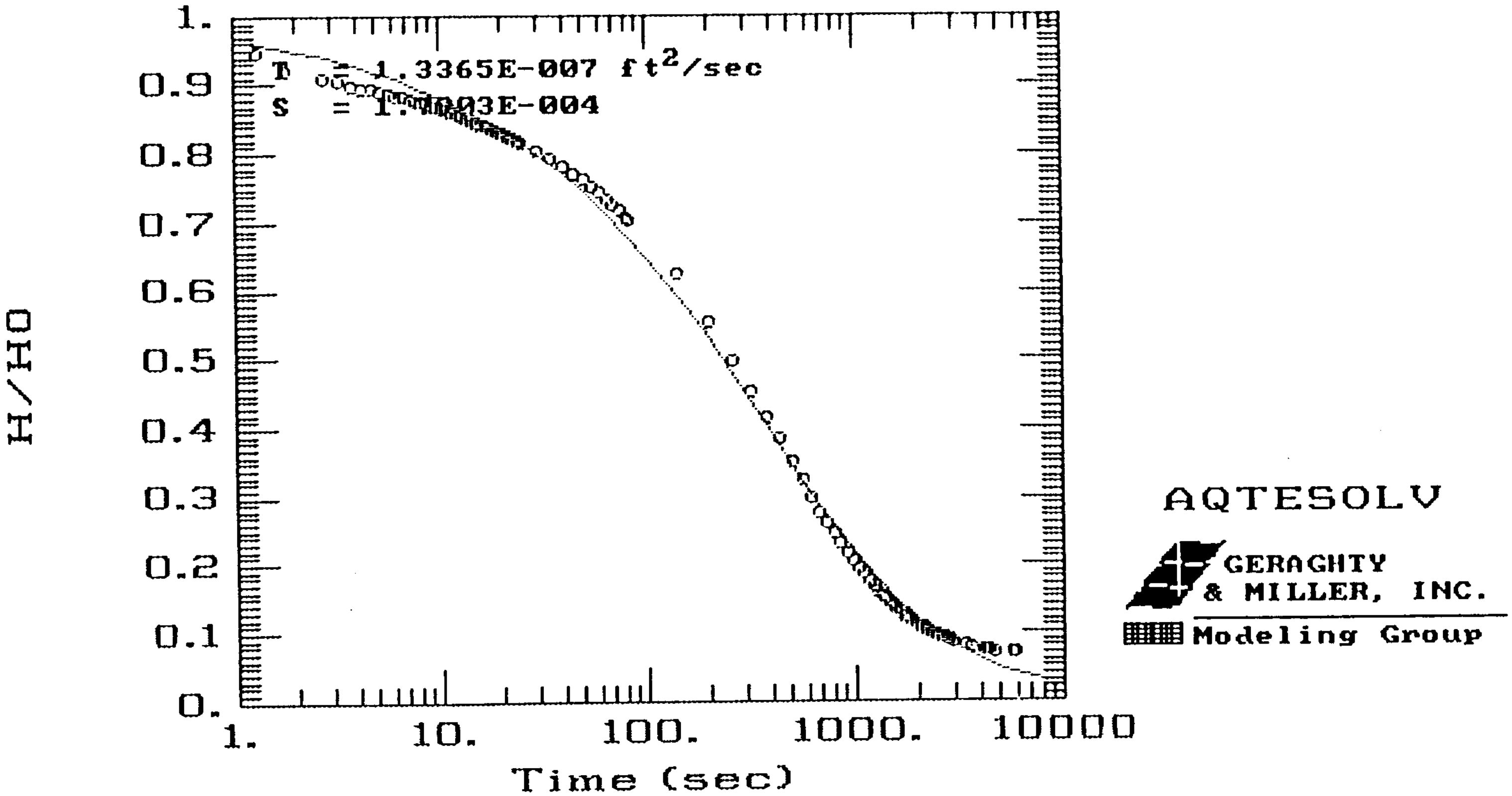
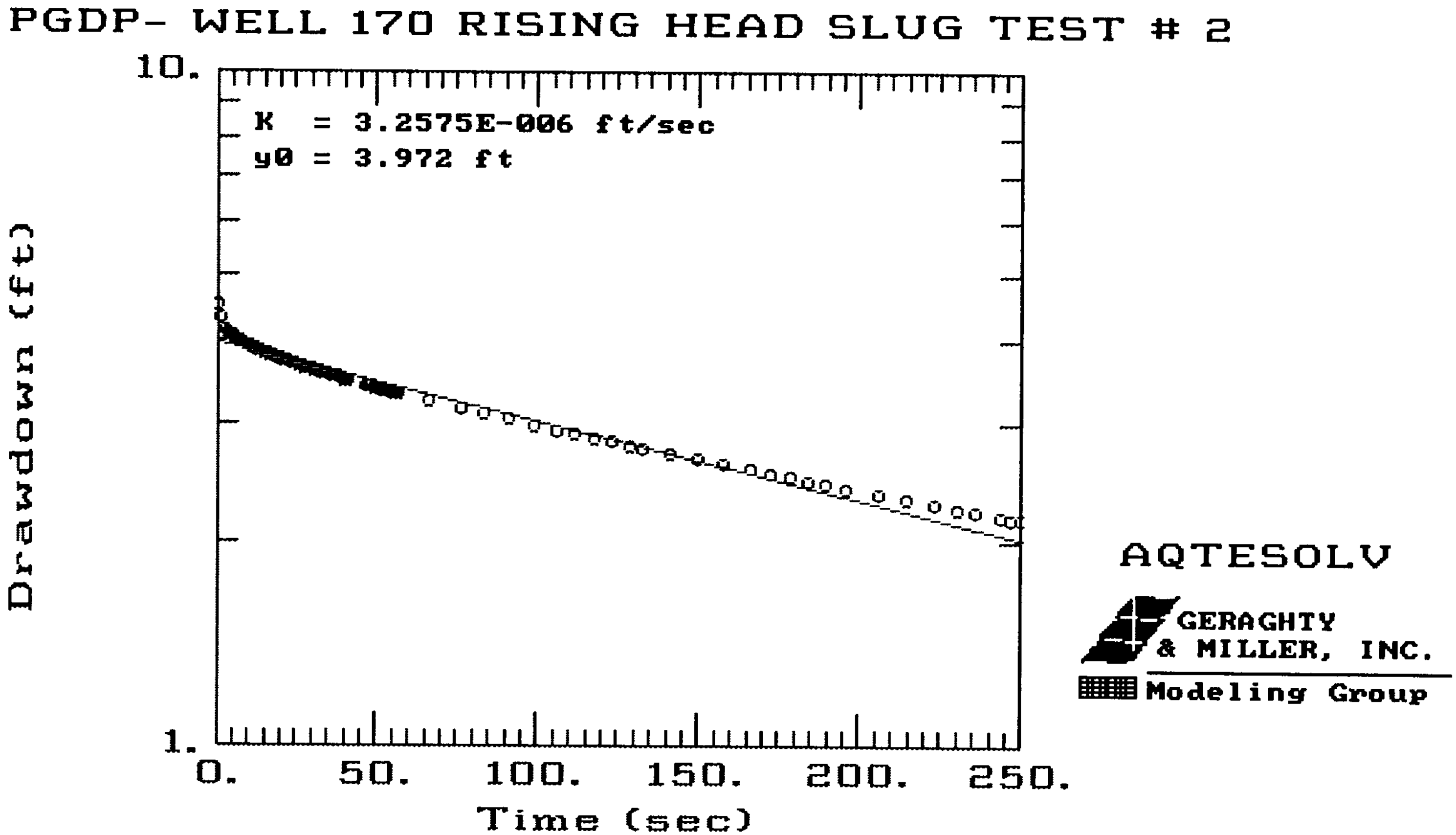
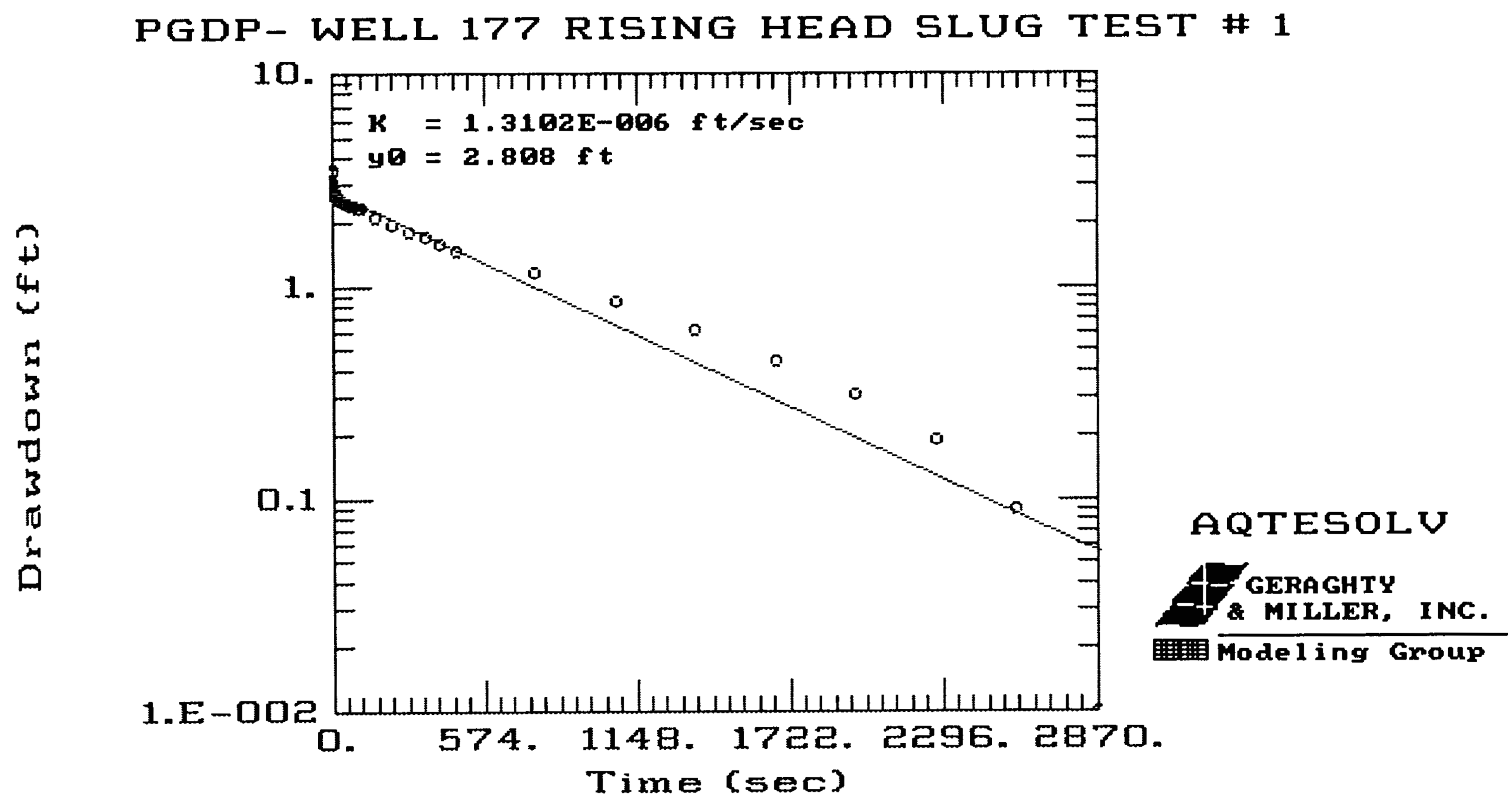


Figure A-10



PGDP- WELL 170 RISING HEAD SLUG TEST # 2
K = 3.2575E-006 ft/sec
y0 = 3.972 ft
10.
1.
Drawdown (ft)
0.
50.
100.
150.
200.
250.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-11


PGDP- WELL 177 RISING HEAD SLUG TEST # 1
K = 1.3102E-006 ft/sec
y0 = 2.808 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
574.
1148.
1722.
2296.
2870.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

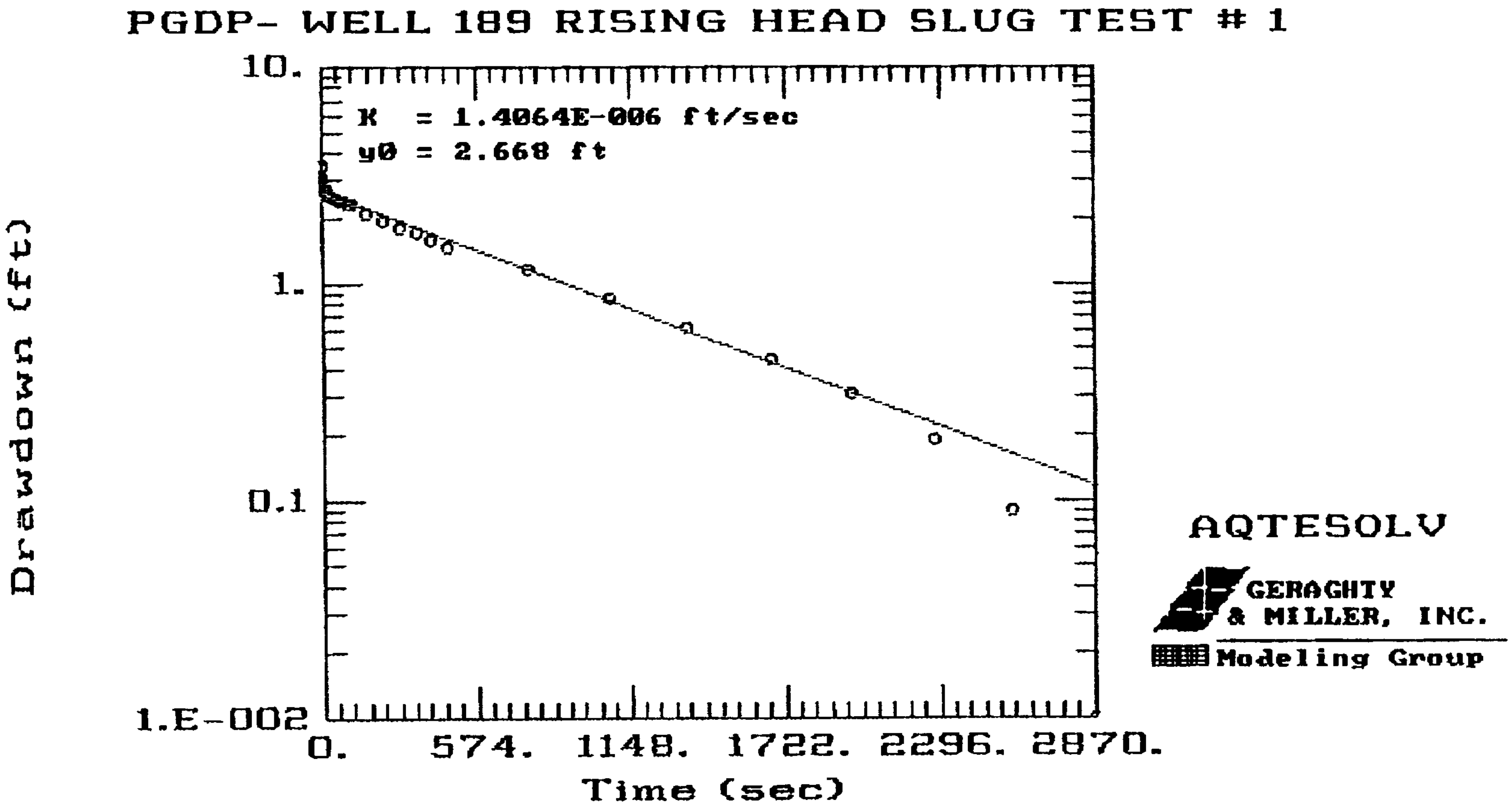

PGDP- WELL 189 RISING HEAD SLUG TEST # 1
K = 1.4064E-006 ft/sec
y0 = 2.668 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
574.
1148.
1722.
2296.
2870.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-13

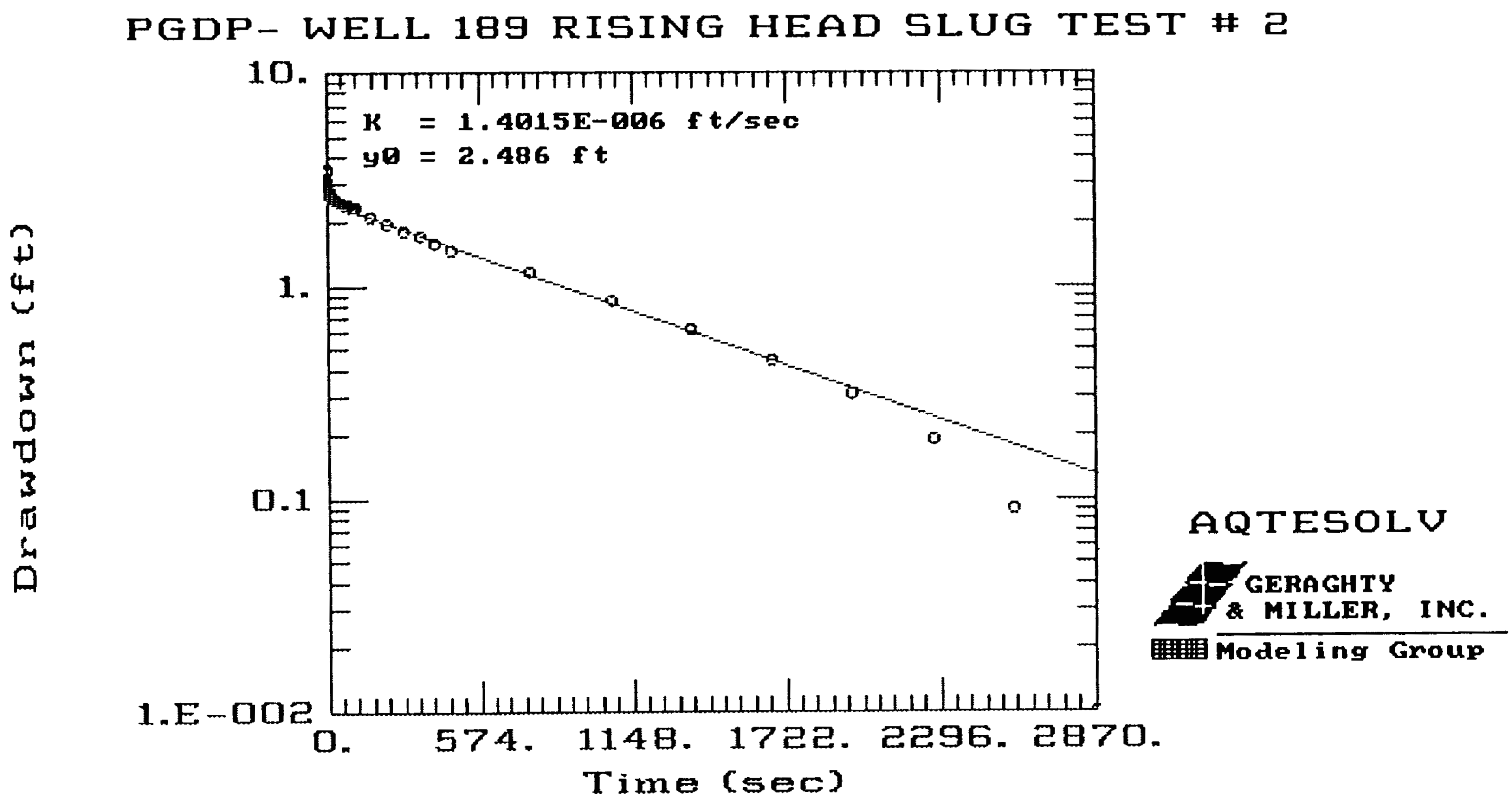
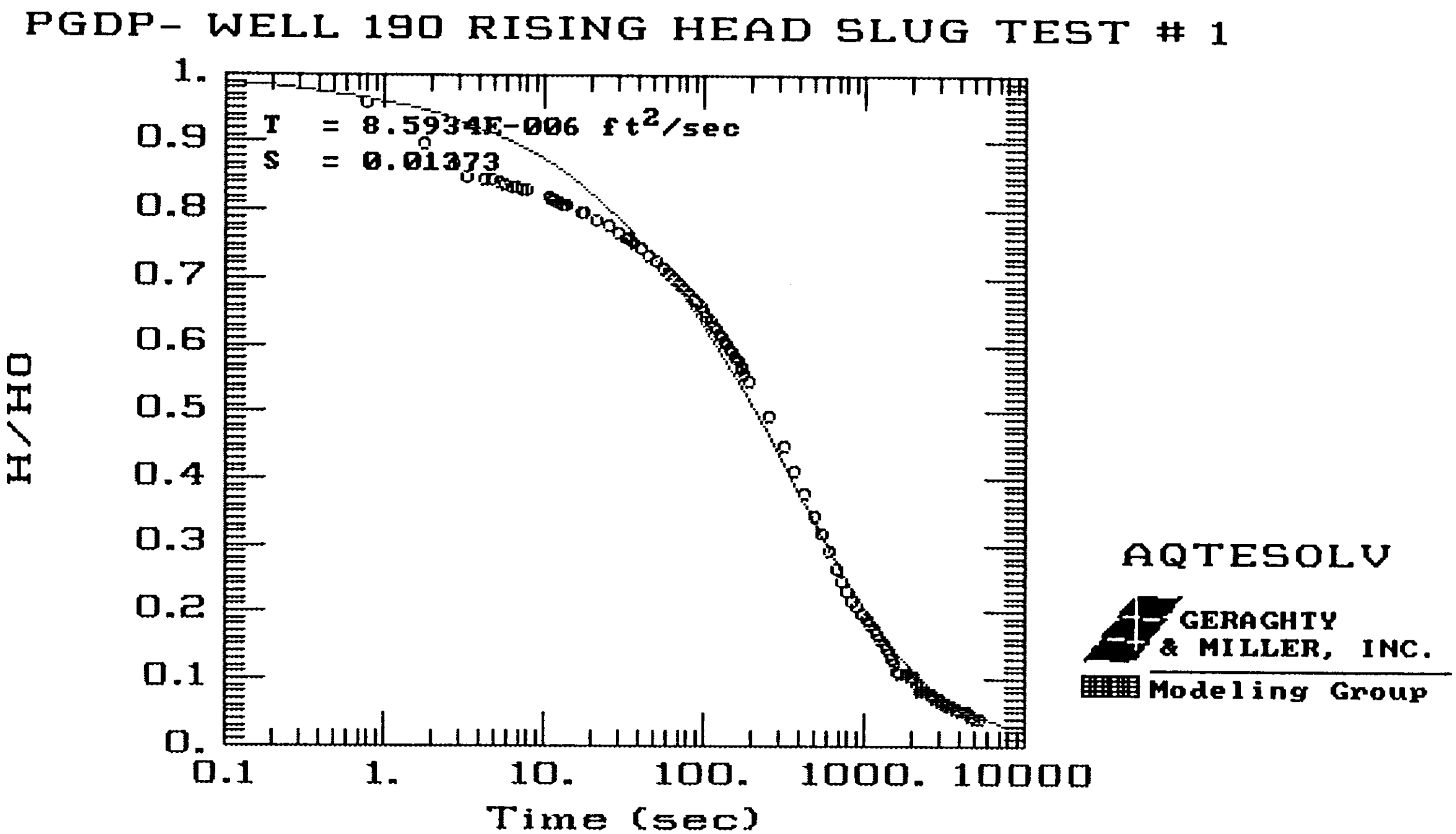
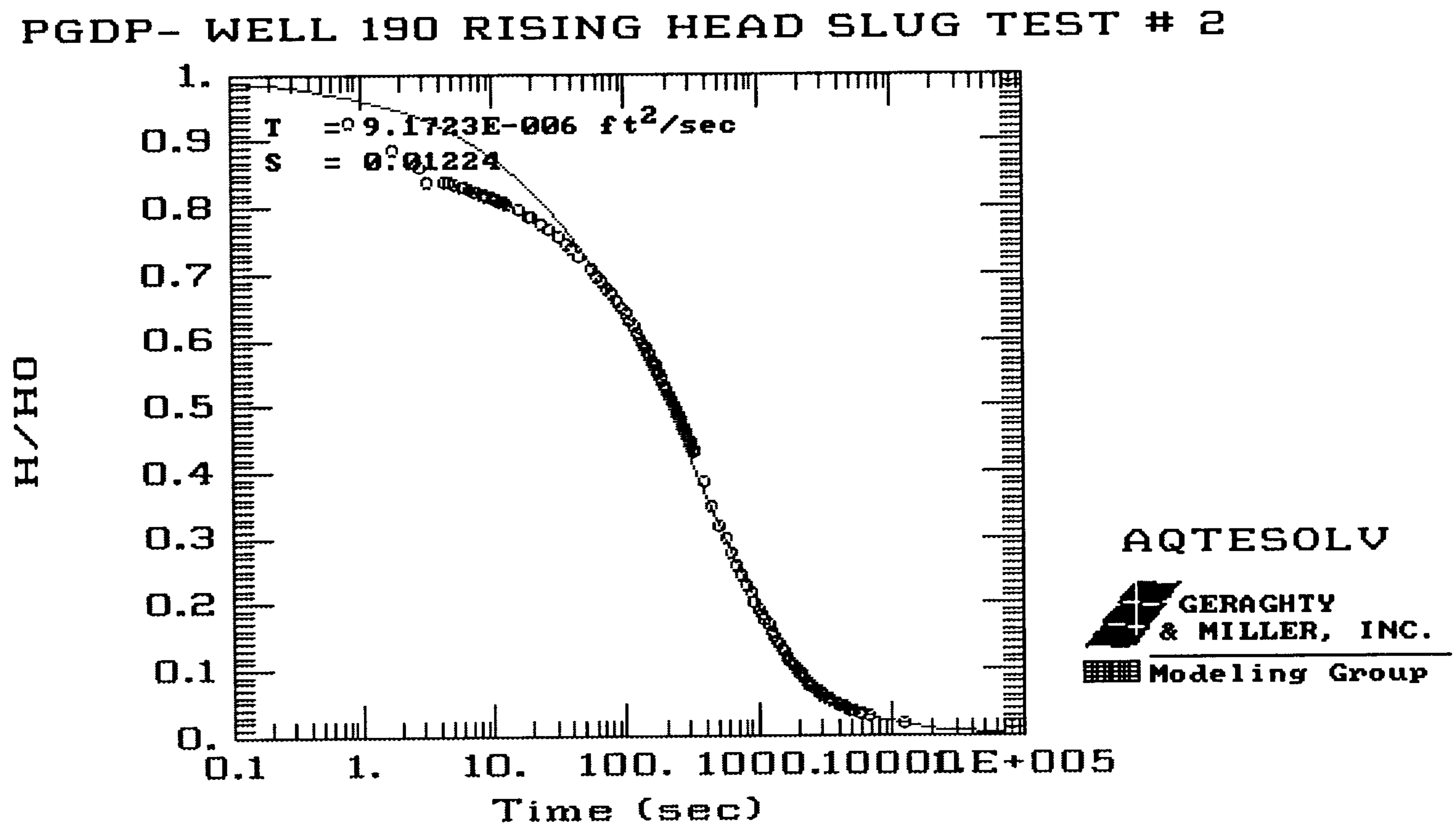

PGDP- WELL 189 RISING HEAD SLUG TEST # 2
K = 1.4015E-006 ft/sec
y0 = 2.486 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
574.
1148.
1722.
2296.
2870.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-14



PGDP- WELL 190 RISING HEAD SLUG TEST # 1
T = 8.5934E-006 ft2/sec
S = 0.01373
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
10000
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-15


PGDP- WELL 190 RISING HEAD SLUG TEST # 2
T = 9.1723E-006 ft²/sec
S = 0.01224
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
10000.
1E+005
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figur 16

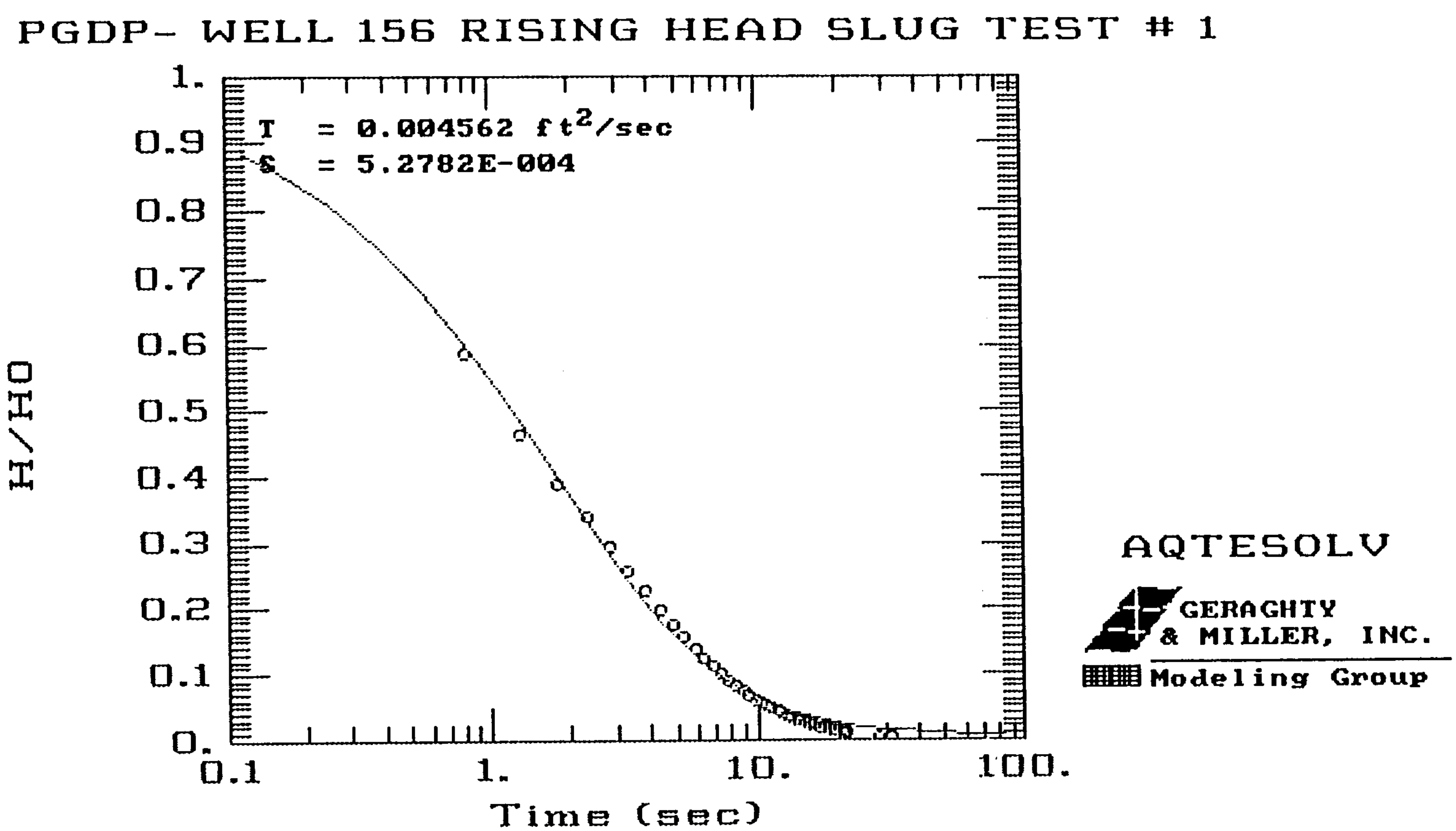

PGDP- WELL 156 RISING HEAD SLUG TEST # 1
T = 0.004562 ft2/sec
S = 5.2782E-004
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-17

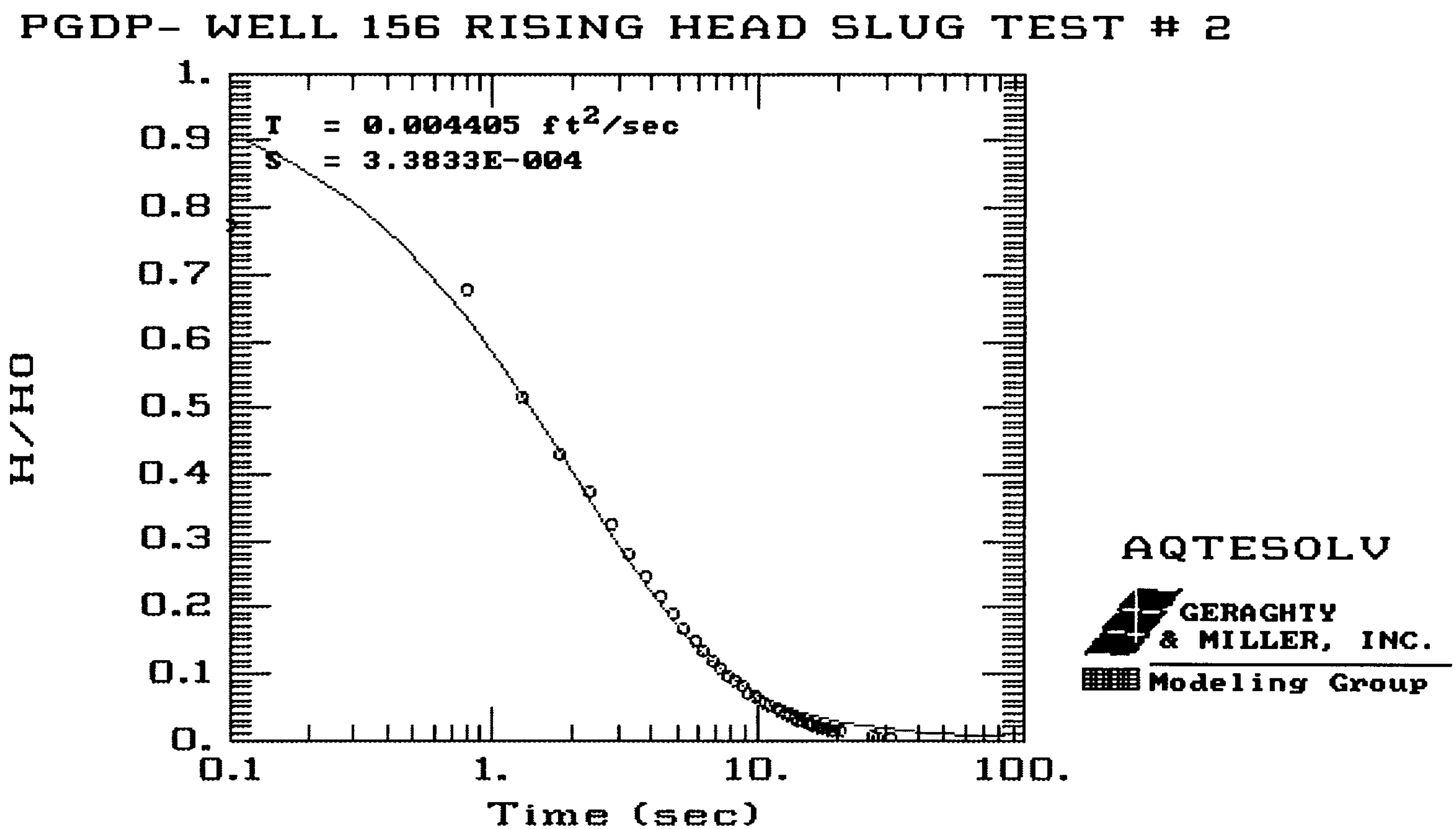

PGDP- WELL 156 RISING HEAD SLUG TEST # 2
T = 0.004405 ft²/sec
S = 3.3833E-004
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-18

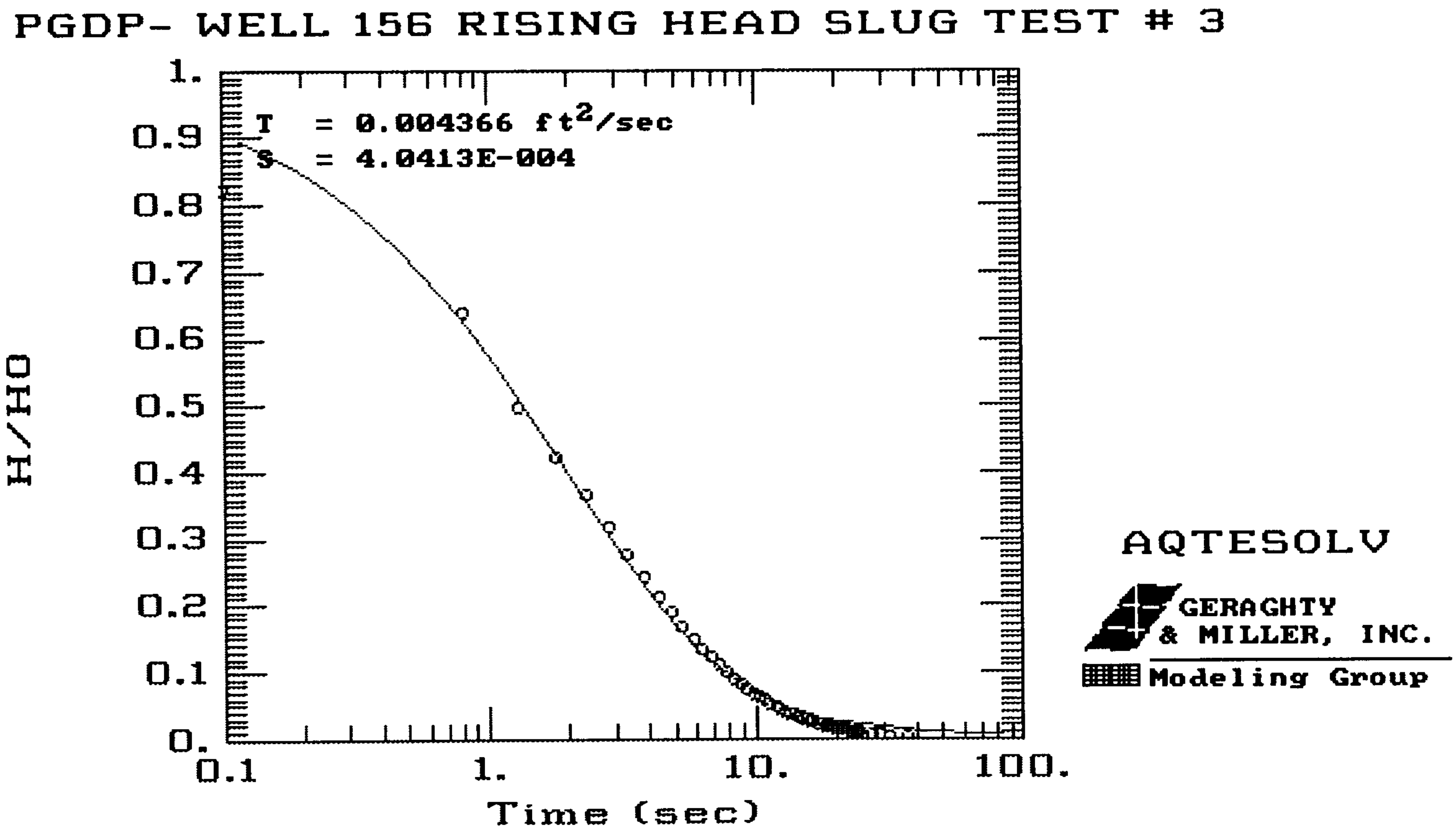

PGDP- WELL 156 RISING HEAD SLUG TEST # 3
T = 0.004366 ft2/sec
S = 4.0413E-004
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-19

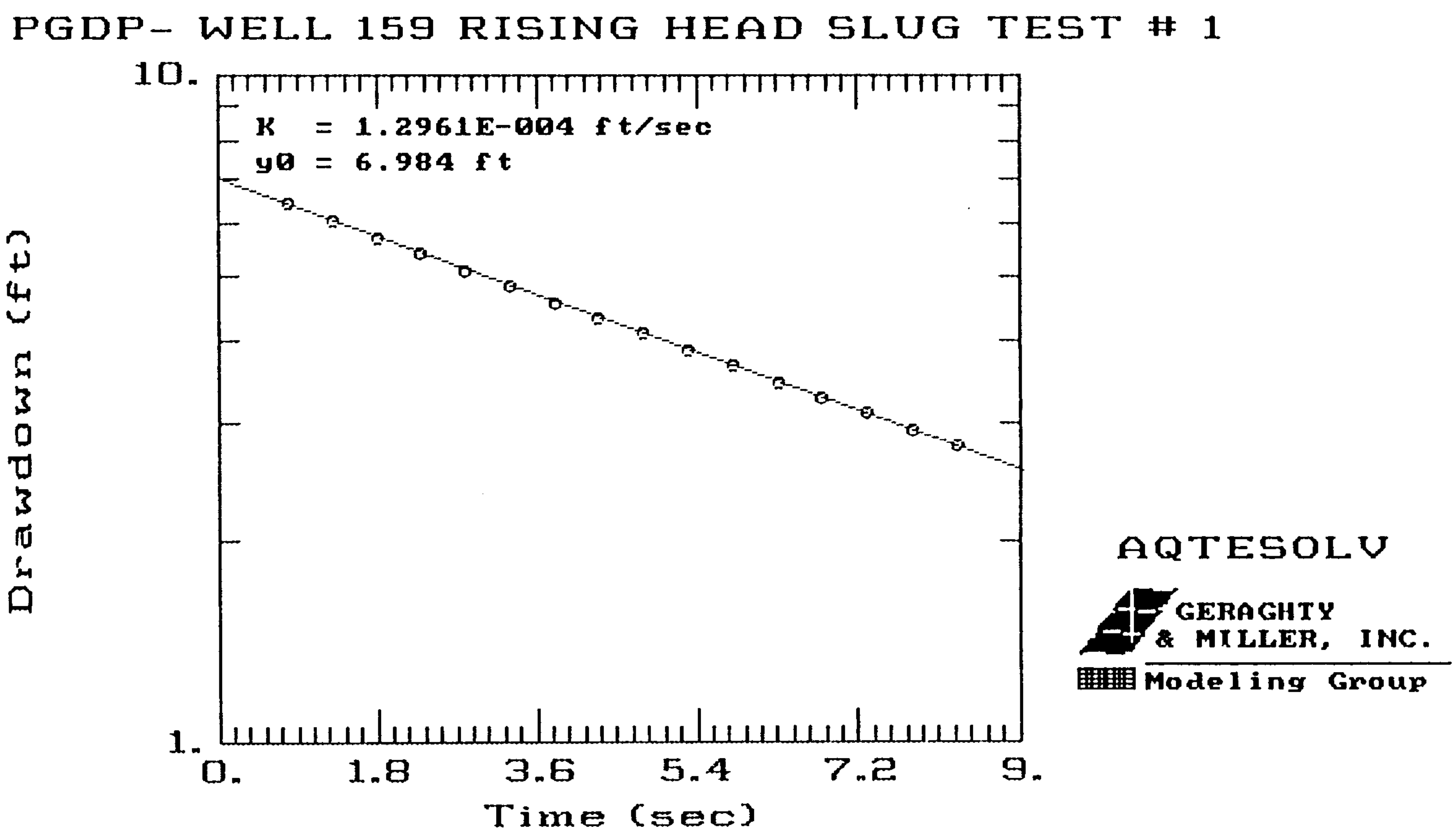

PGDP- WELL 159 RISING HEAD SLUG TEST # 1
K = 1.2961E-004 ft/sec
y0 = 6.984 ft
10.
1.
0.
1.8
3.6
5.4
7.2
9.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-20

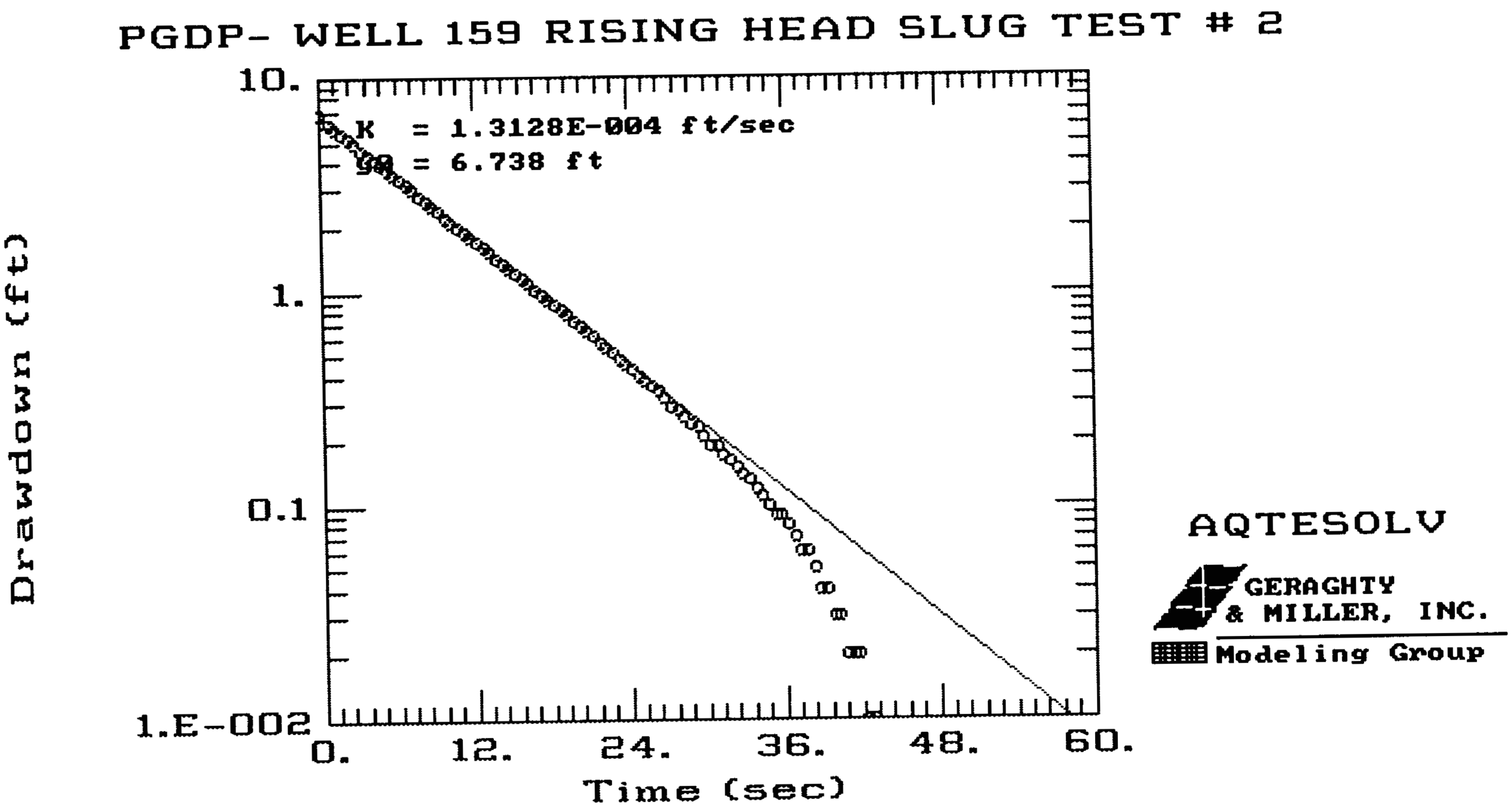

PGDP- WELL 159 RISING HEAD SLUG TEST # 2
K = 1.3128E-004 ft/sec
y0 = 6.738 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
12.
24.
36.
48.
60.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-21

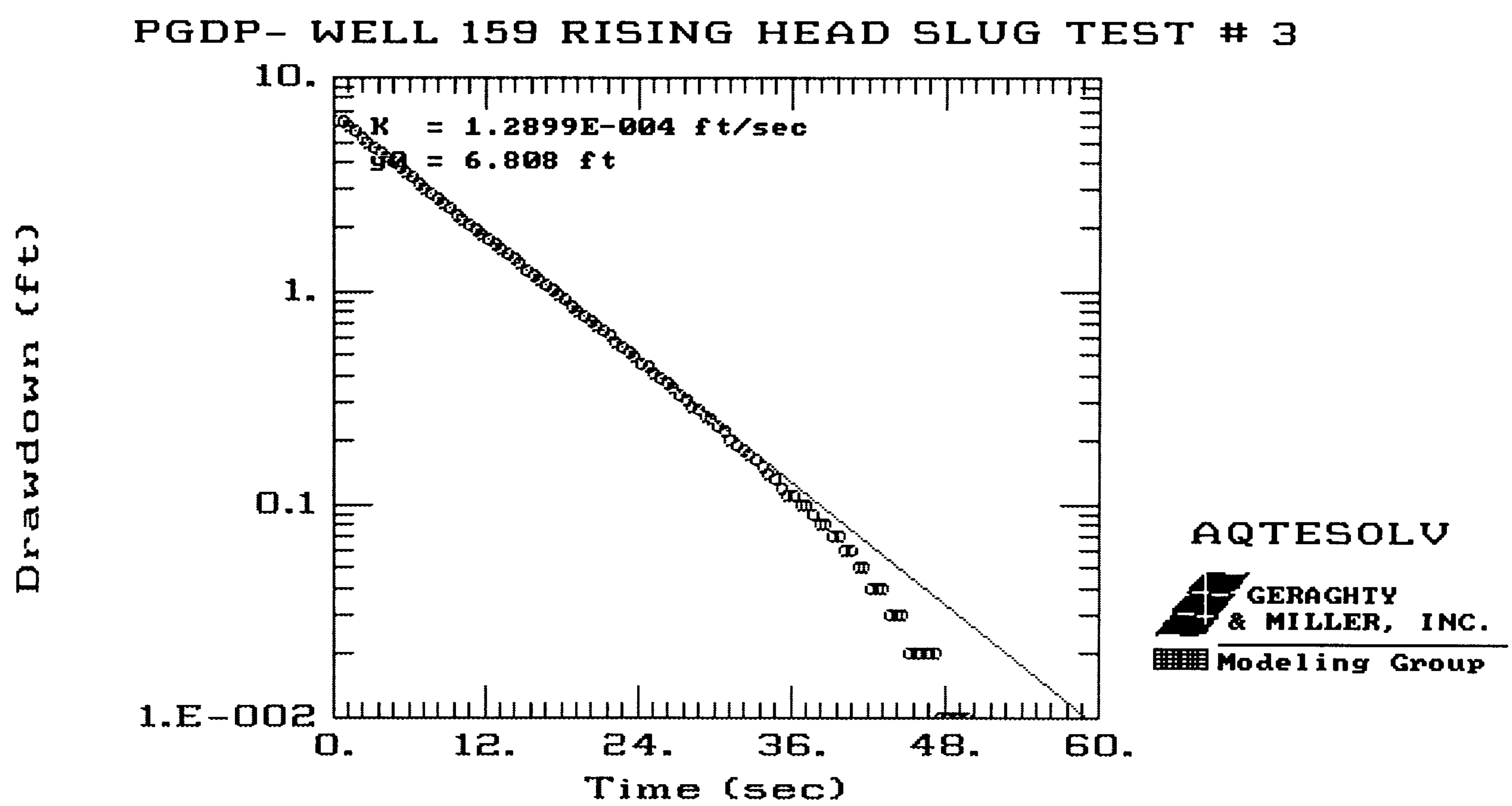
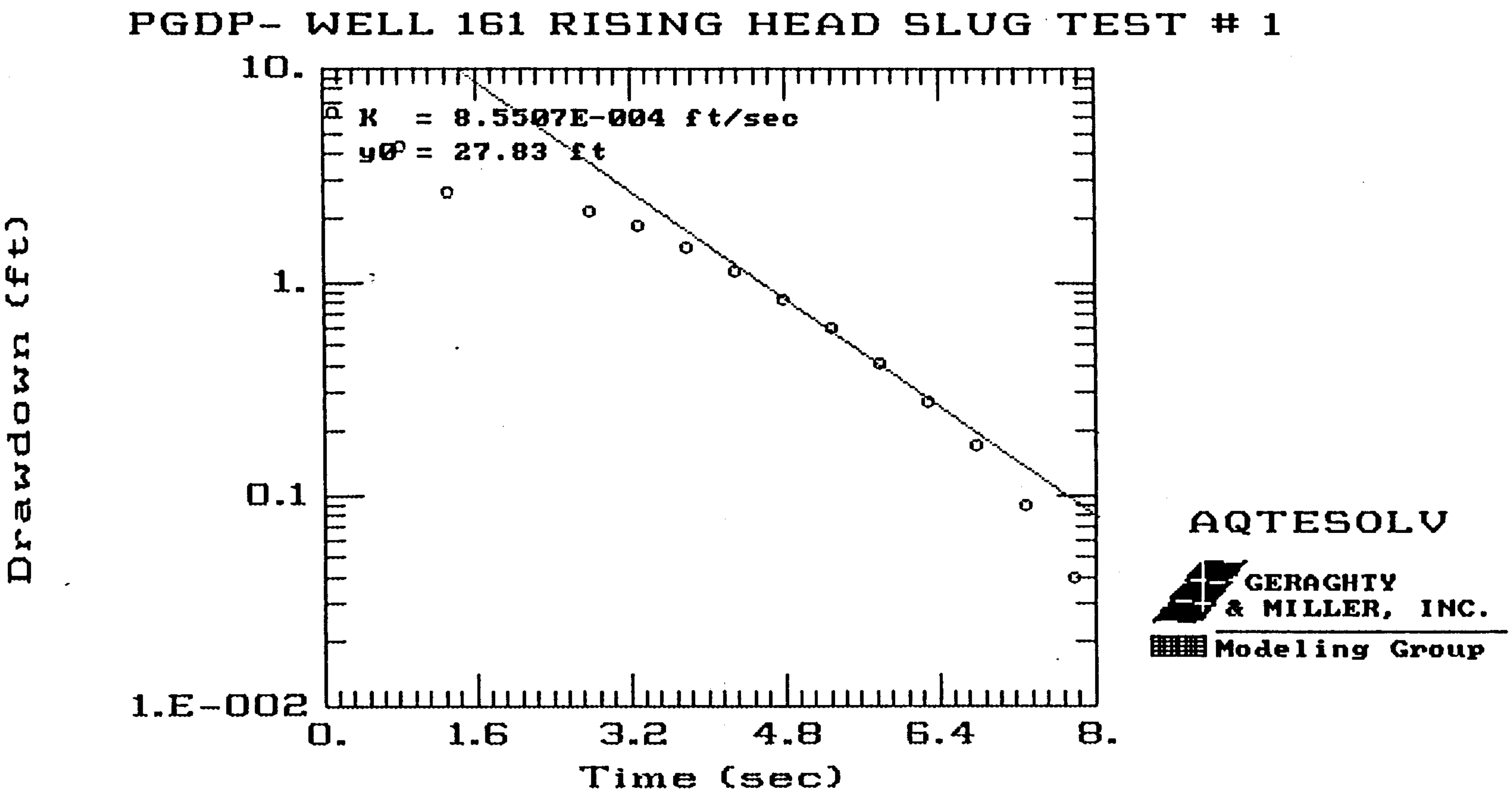
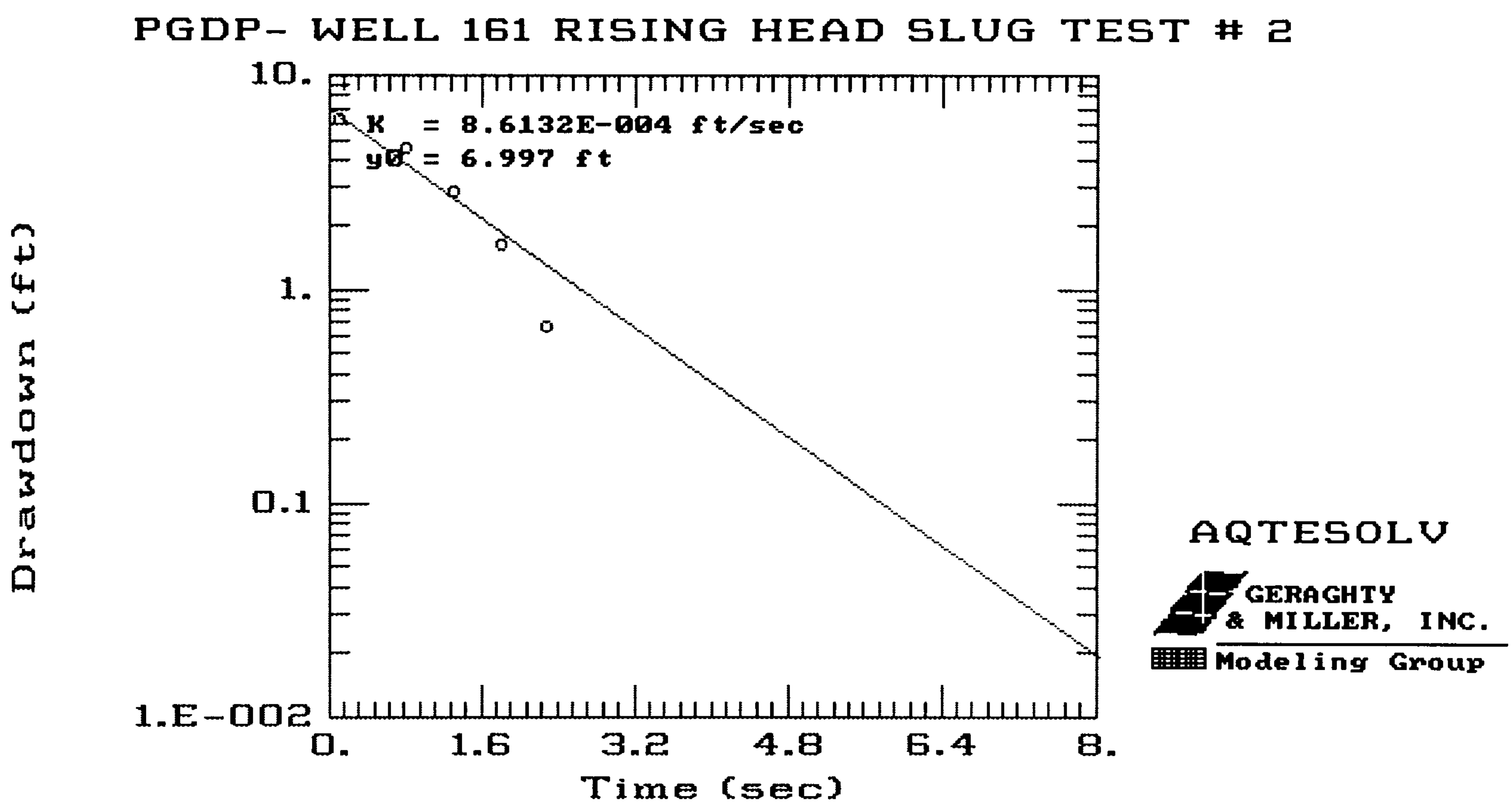

PGDP- WELL 159 RISING HEAD SLUG TEST # 3
K = 1.2899E-004 ft/sec
y0 = 6.808 ft
10.
1.
0.1
1.E-002
0.
12.
24.
36.
48.
60.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-22



PGDP- WELL 161 RISING HEAD SLUG TEST # 1
K = 8.5507E-004 ft/sec
y0 = 27.83 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1.6
3.2
4.8
6.4
8.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-23



PGDP- WELL 161 RISING HEAD SLUG TEST # 2
K = 8.6132E-004 ft/sec
y0 = 6.997 ft
10.
1.
0.1
1.E-002
0.
1.6
3.2
4.8
6.4
8.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-24

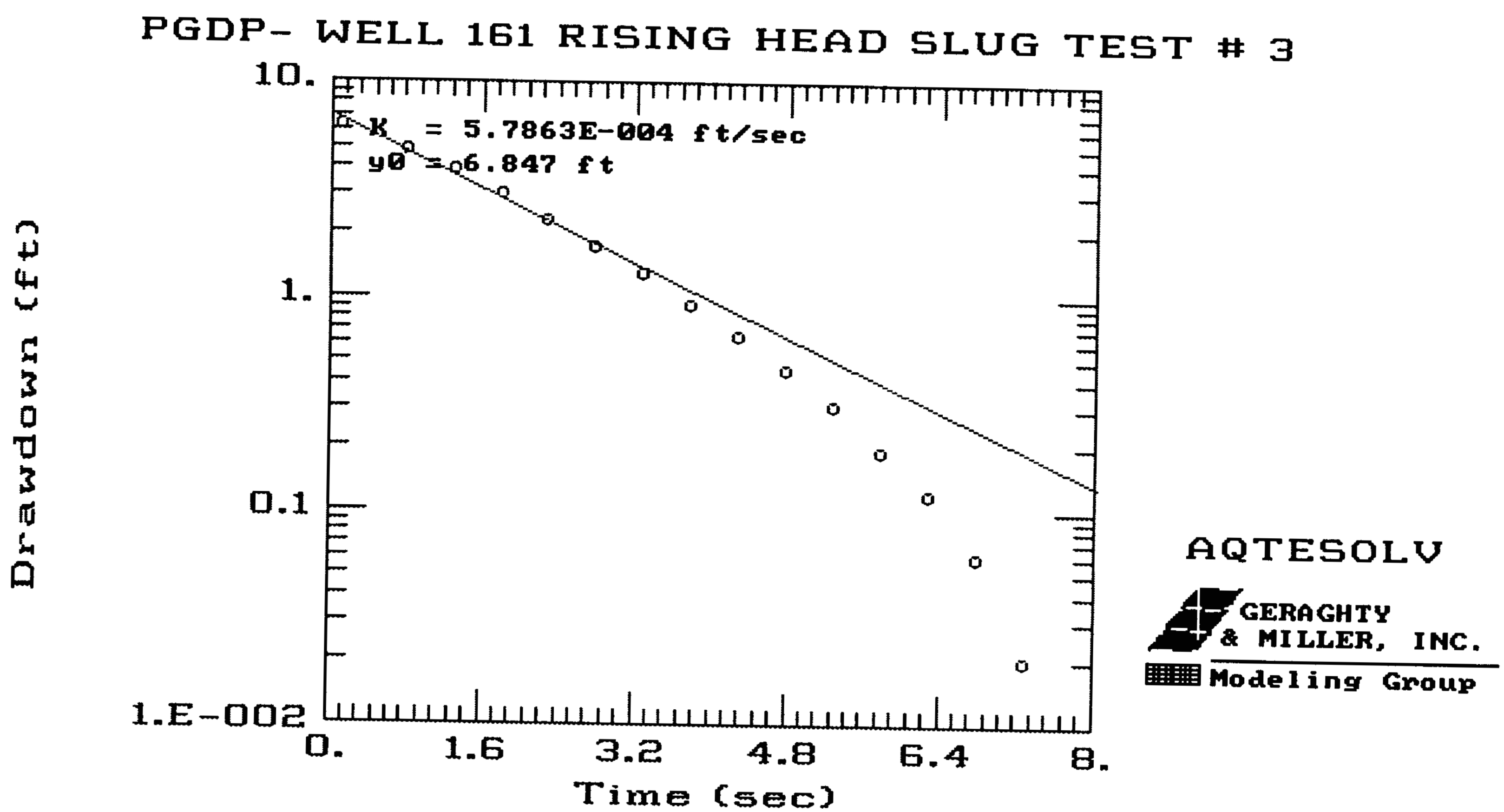
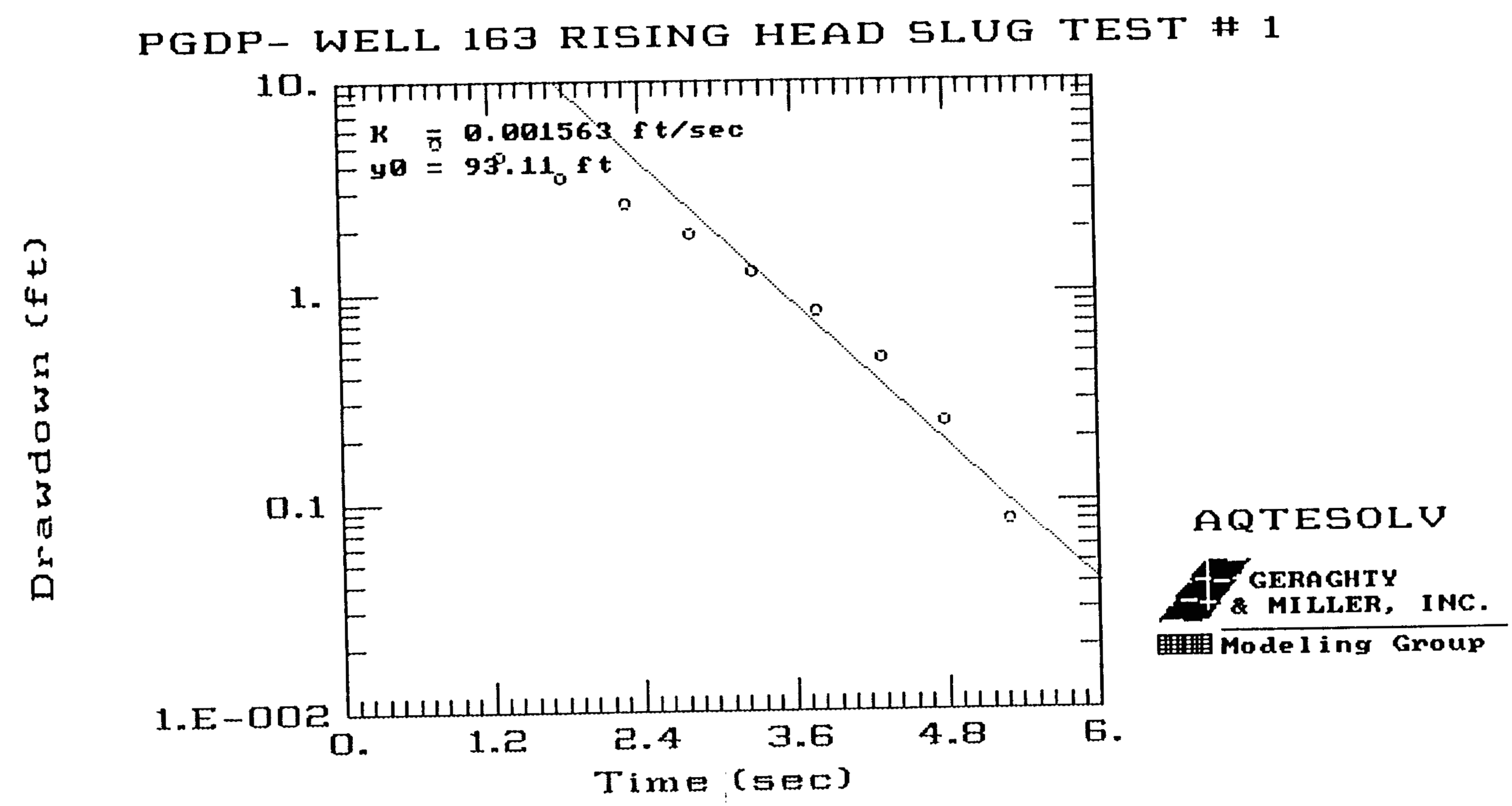

PGDP- WELL 161 RISING HEAD SLUG TEST # 3
K = 5.7863E-004 ft/sec
y0 = 6.847 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1.6
3.2
4.8
6.4
8.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-25



PGDP- WELL 163 RISING HEAD SLUG TEST # 1
K = 0.001563 ft/sec
y0 = 93.11 ft
10.
1.
0.1
1.E-002
0.
1.2
2.4
3.6
4.8
6.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-26

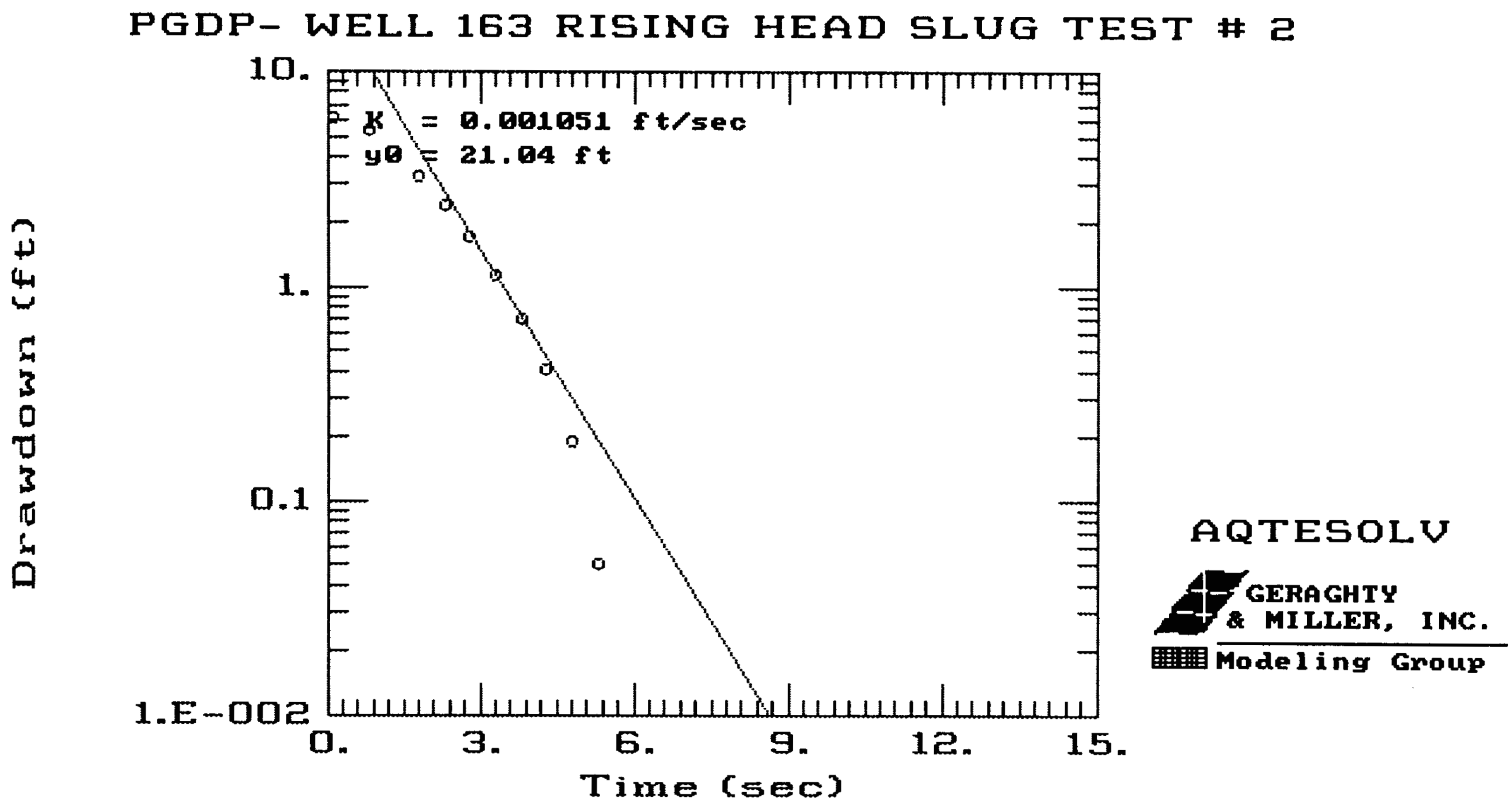

PGDP- WELL 163 RISING HEAD SLUG TEST # 2
K = 0.001051 ft/sec
y0 = 21.04 ft
10.
1.
0.1
1.E-002
0.
3.
6.
9.
12.
15.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-27

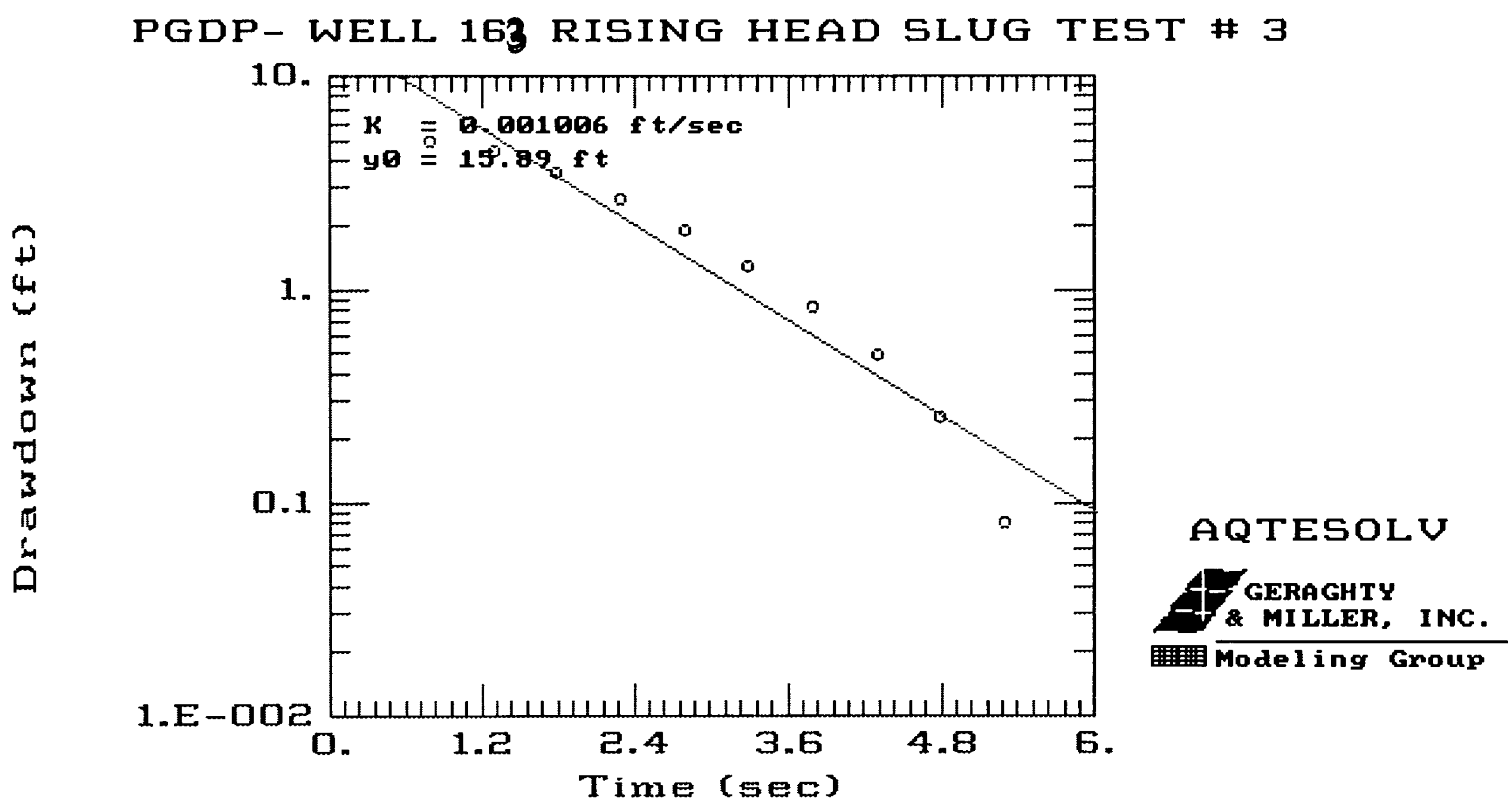

PGDP- WELL 163 RISING HEAD SLUG TEST # 3
K = 0.001006 ft/sec
y0 = 15.89 ft
Drawdown (ft)
Time (sec)
10.
1.
0.1
1.E-002
0.
1.2
2.4
3.6
4.8
6.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-28

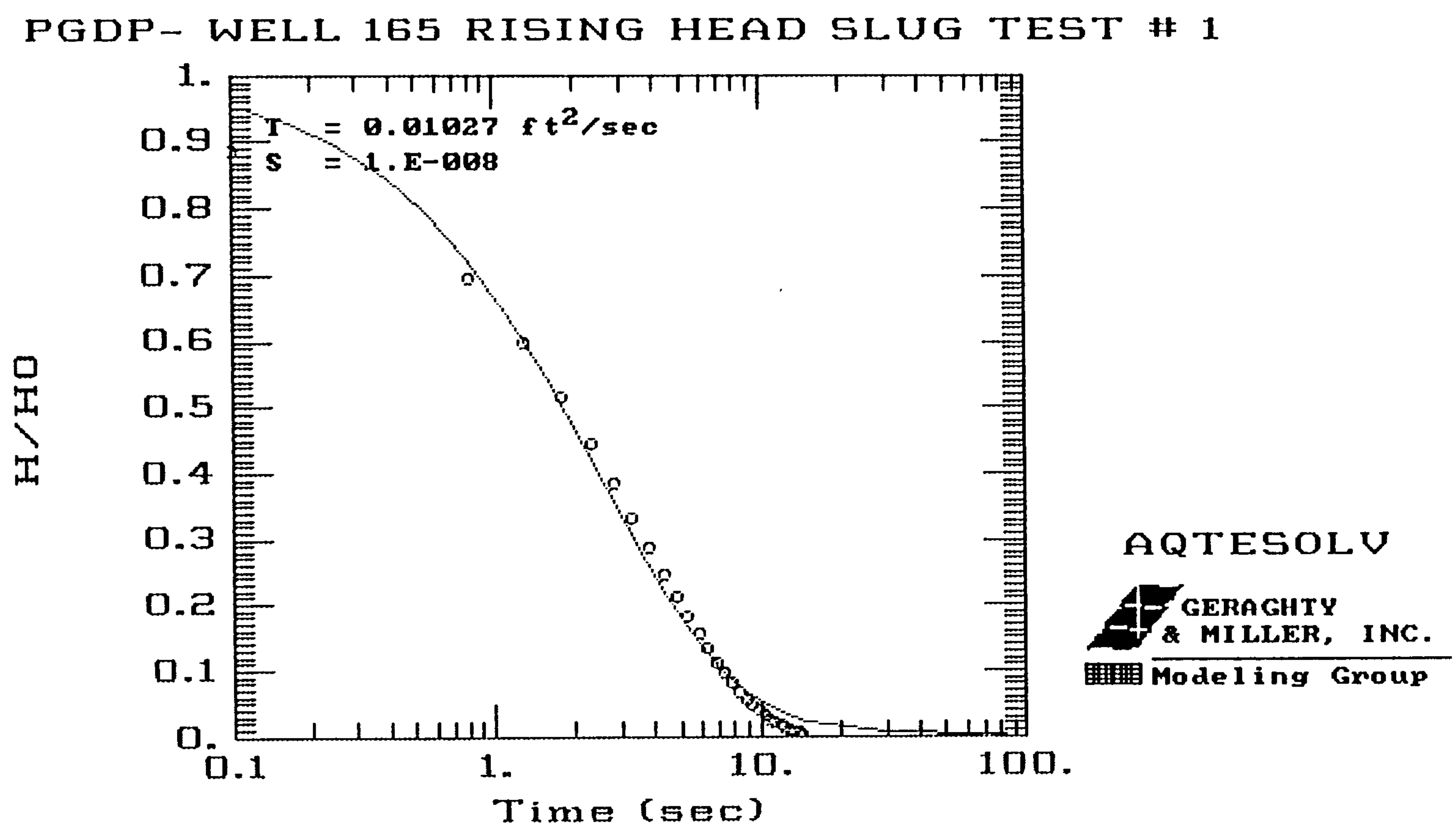

PGDP- WELL 165 RISING HEAD SLUG TEST # 1
T = 0.01027 ft^2/sec
S = 1.E-008
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-29

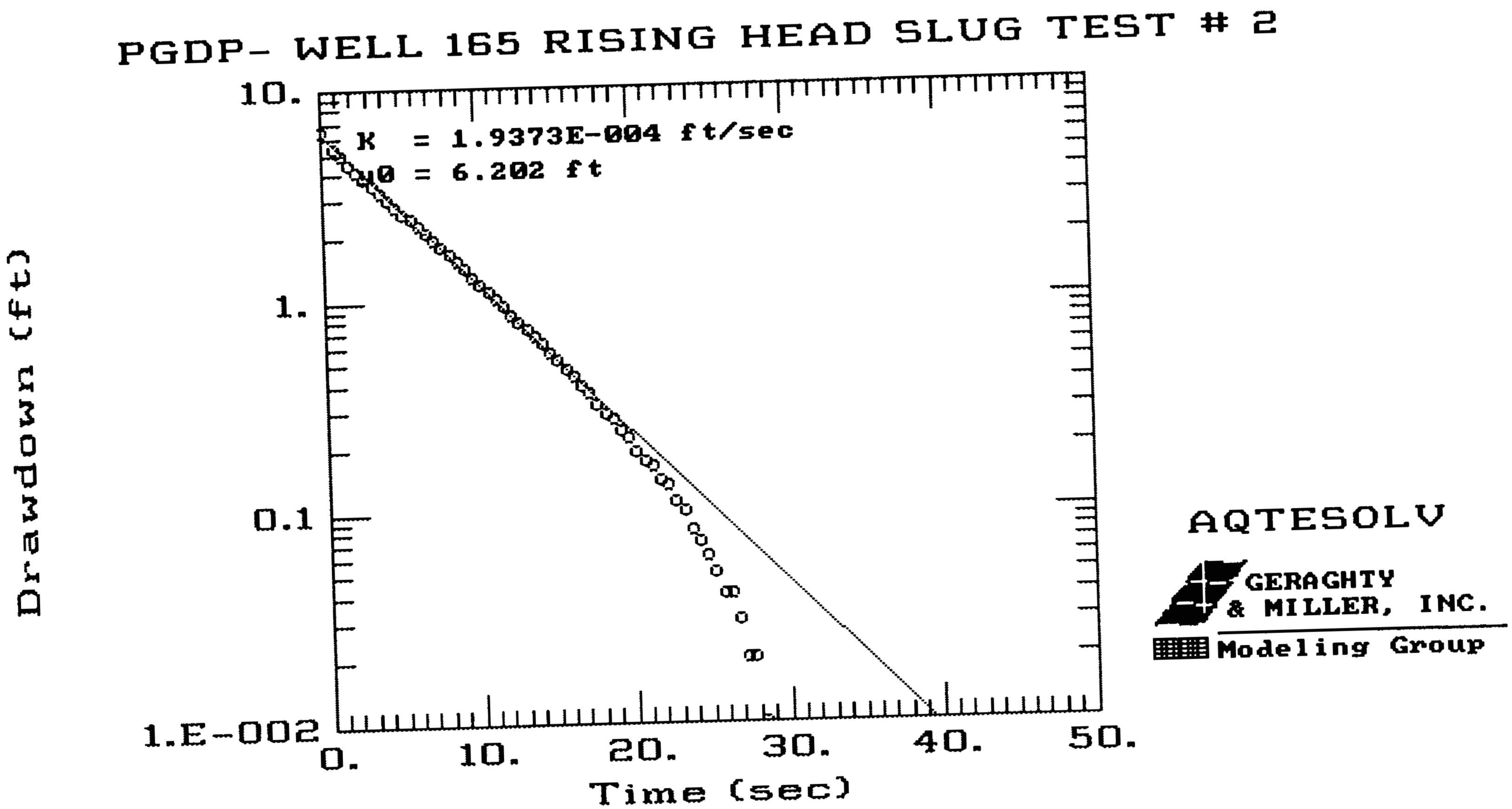
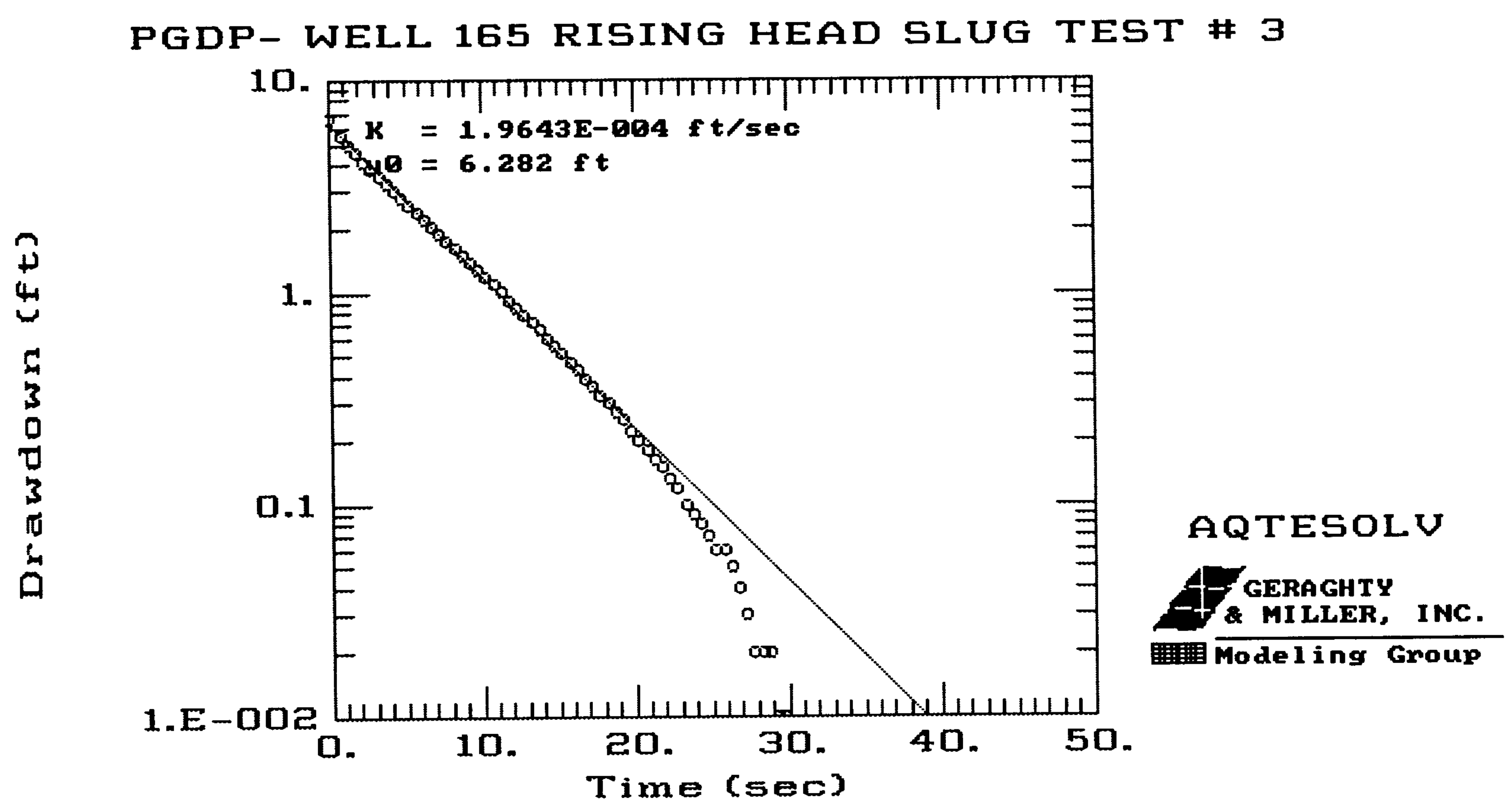

PGDP- WELL 165 RISING HEAD SLUG TEST # 2
K = 1.9373E-004 ft/sec
y0 = 6.202 ft
10.
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-30



PGDP- WELL 165 RISING HEAD SLUG TEST # 3
K = 1.9643E-004 ft/sec
y0 = 6.282 ft
10.
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-31

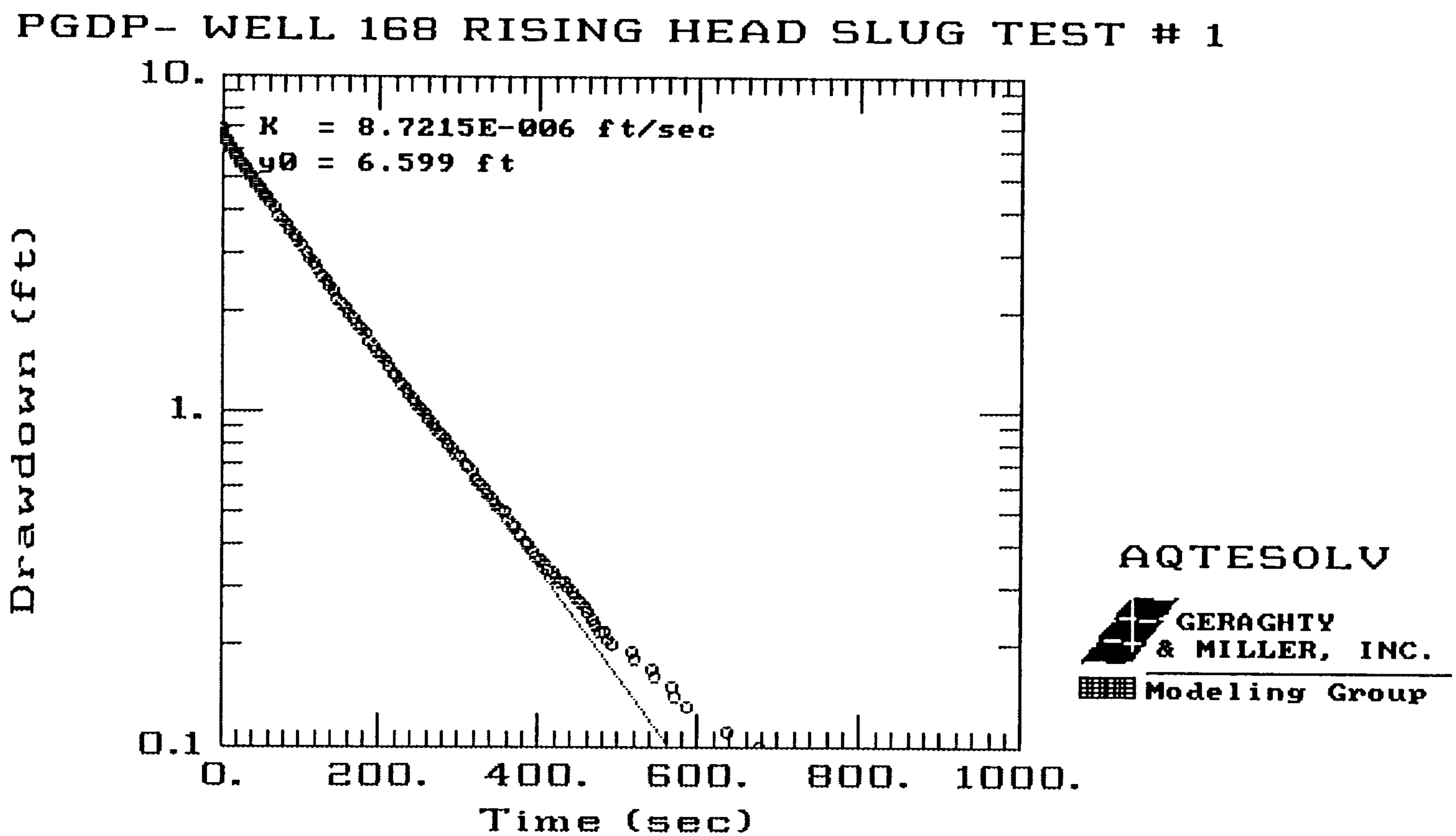
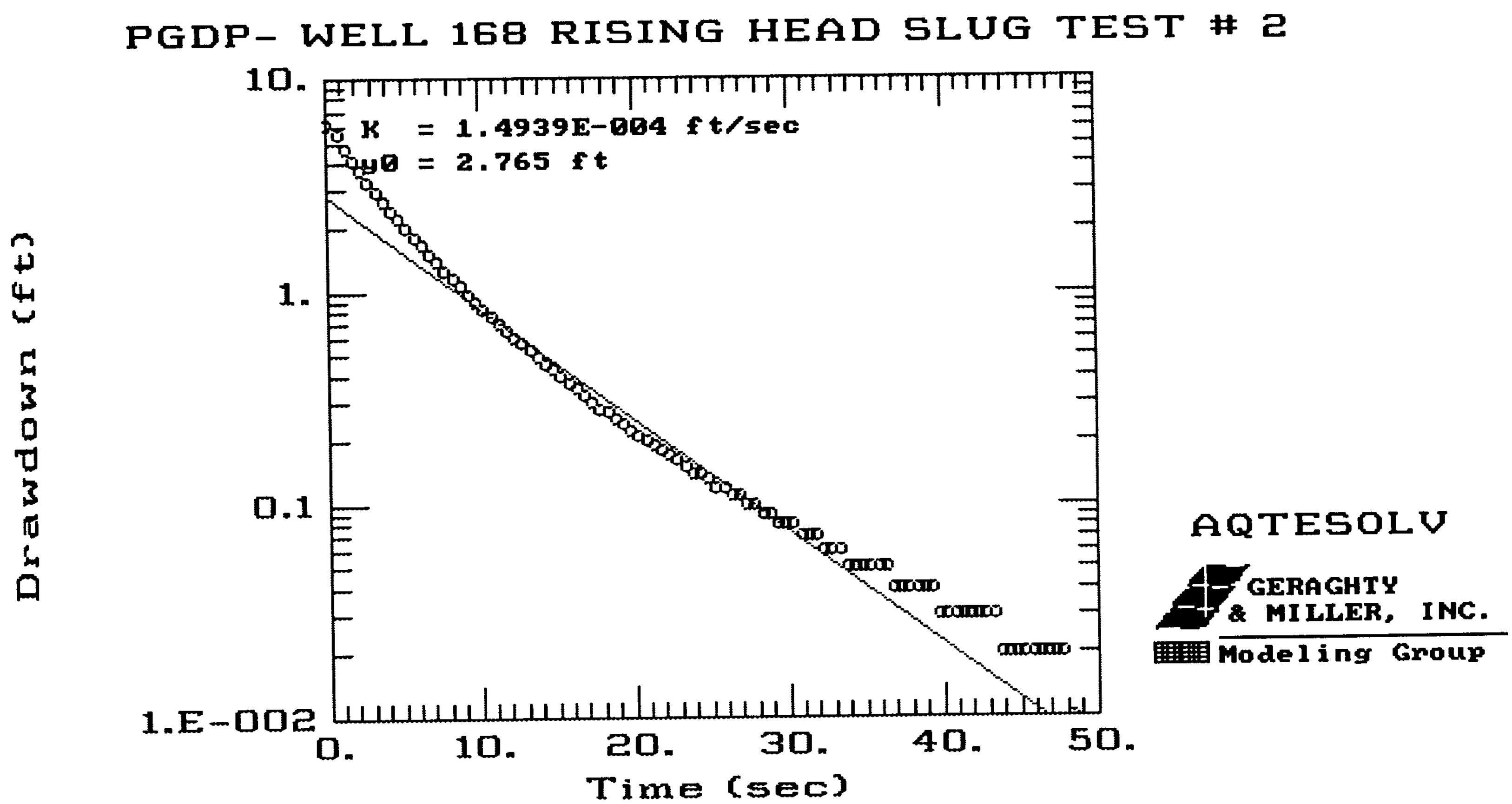
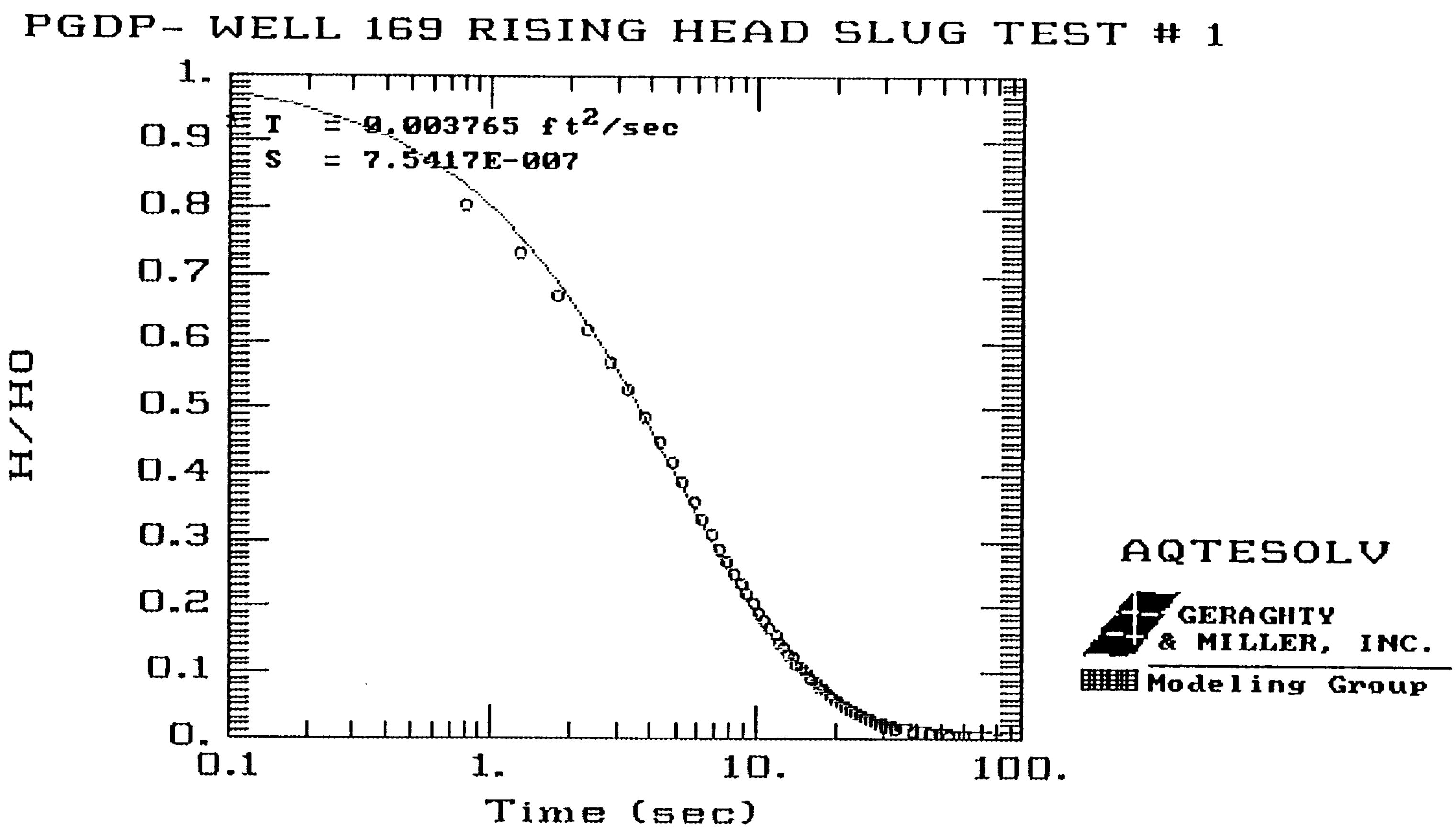

PGDP- WELL 168 RISING HEAD SLUG TEST # 1
K = 8.7215E-006 ft/sec
y0 = 6.599 ft
Drawdown (ft)
10.
1.
0.1
0.
200.
400.
600.
800.
1000.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-32



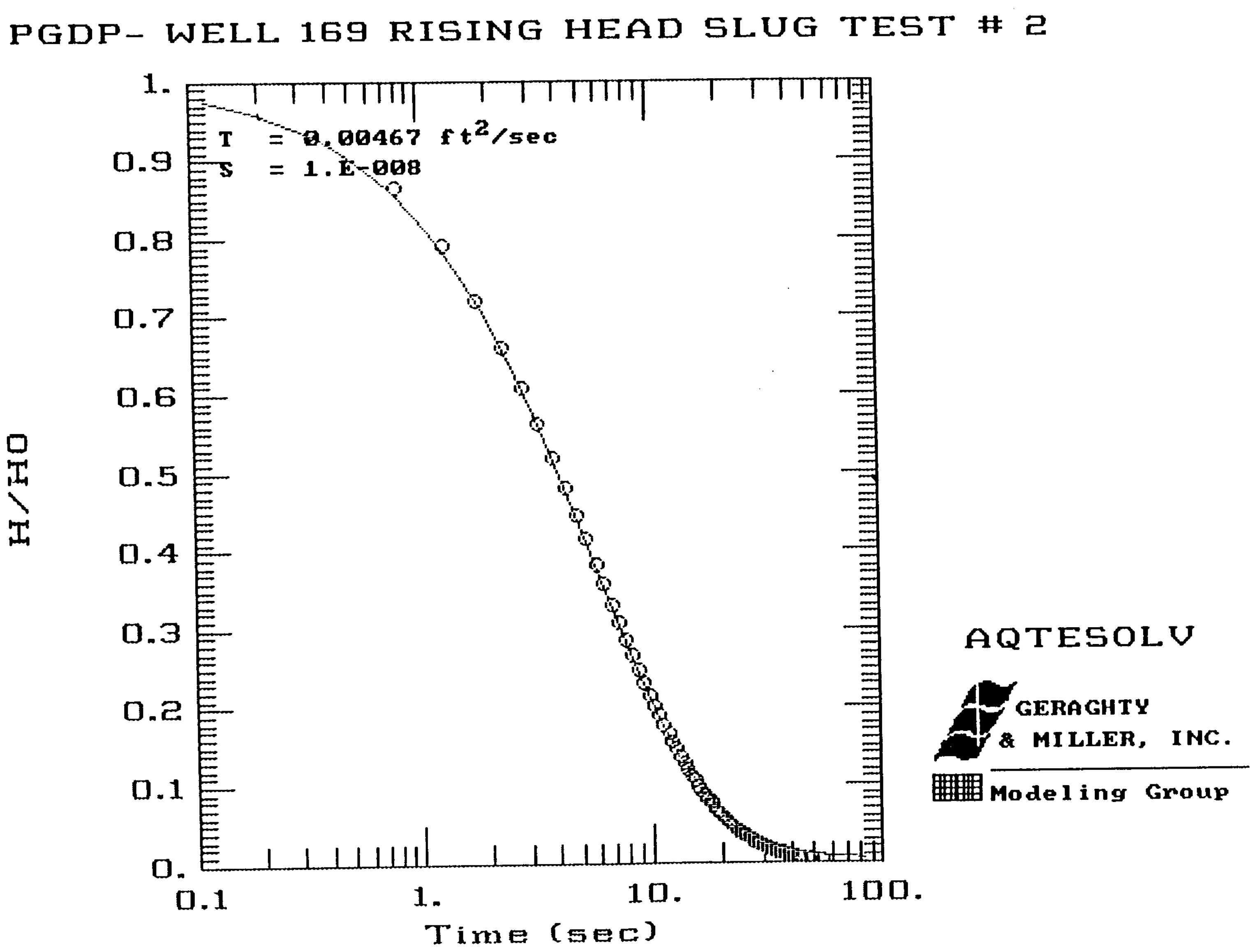
PGDP- WELL 168 RISING HEAD SLUG TEST # 2
K = 1.4939E-004 ft/sec
y0 = 2.765 ft
10.
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-33



PGDP- WELL 169 RISING HEAD SLUG TEST # 1
T = 0.003765 ft2/sec
S = 7.5417E-007
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
H/HO
0.1
1.
10.
100.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

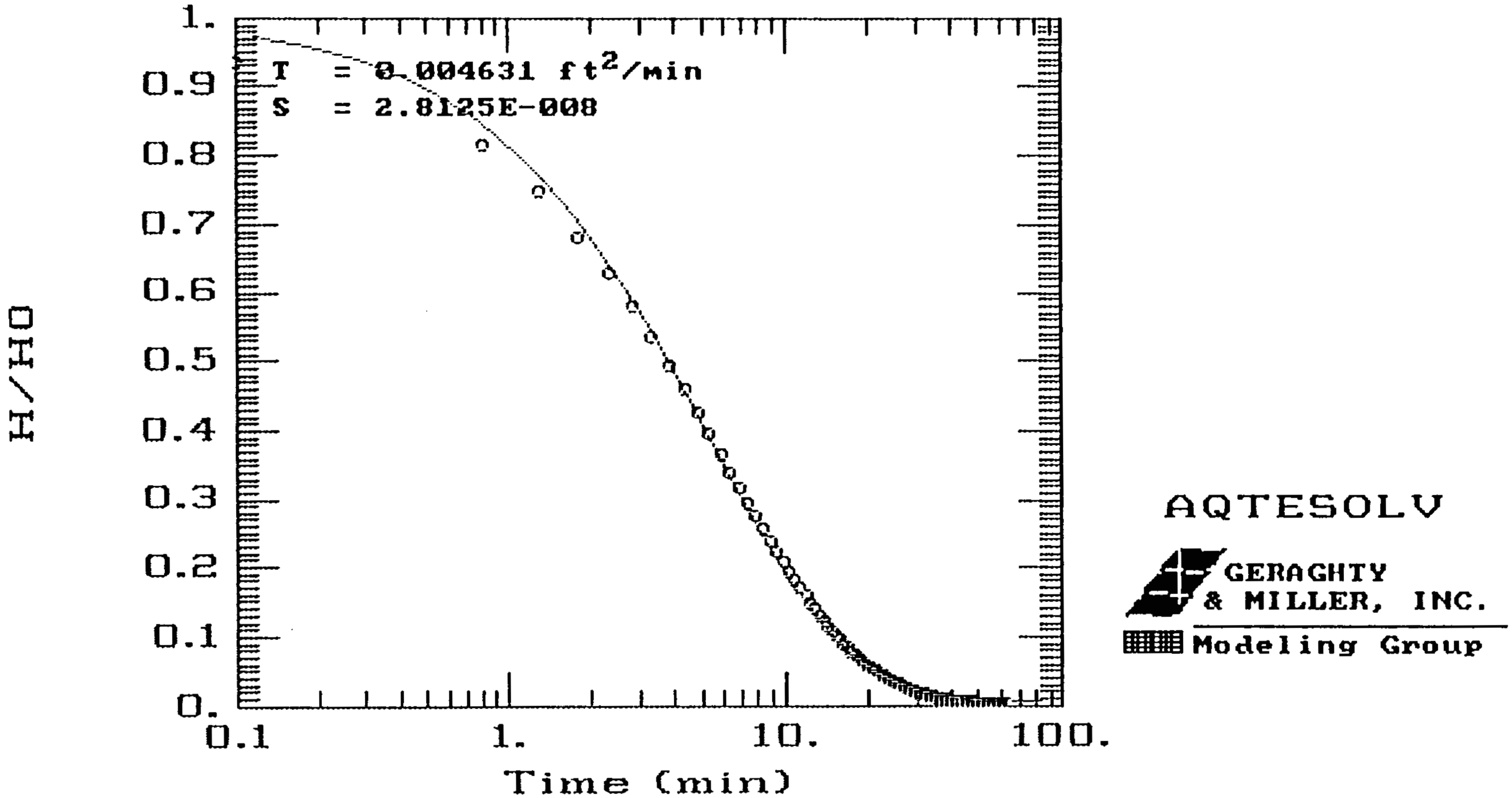
Figure A-34



PGDP- WELL 169 RISING HEAD SLUG TEST # 2
T = 0.00467 ft²/sec
S = 1.E-008
H/H0
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-35

PGDP- WELL 169 RISING HEAD SLUG TEST # 3



..gure A-36

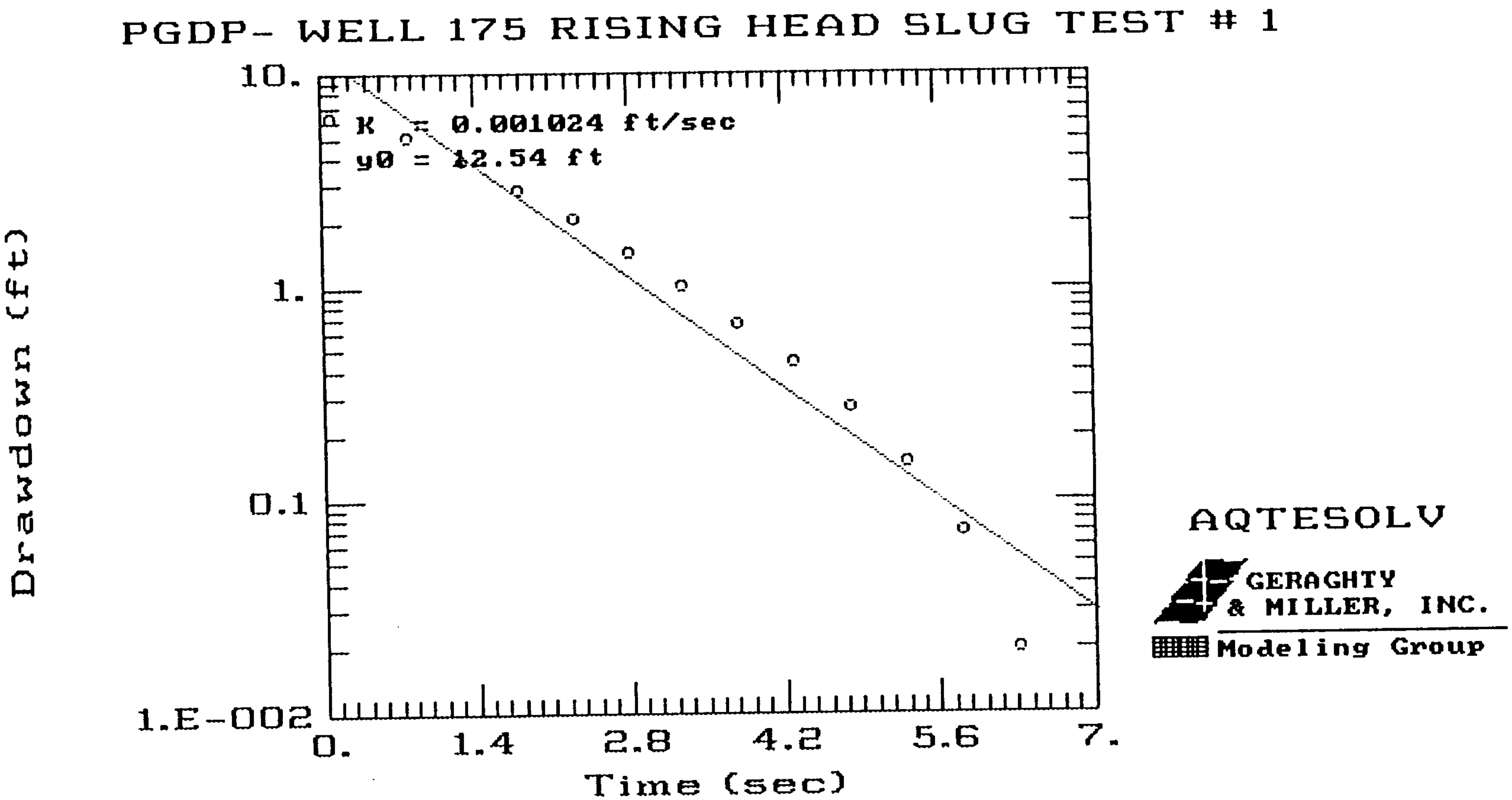
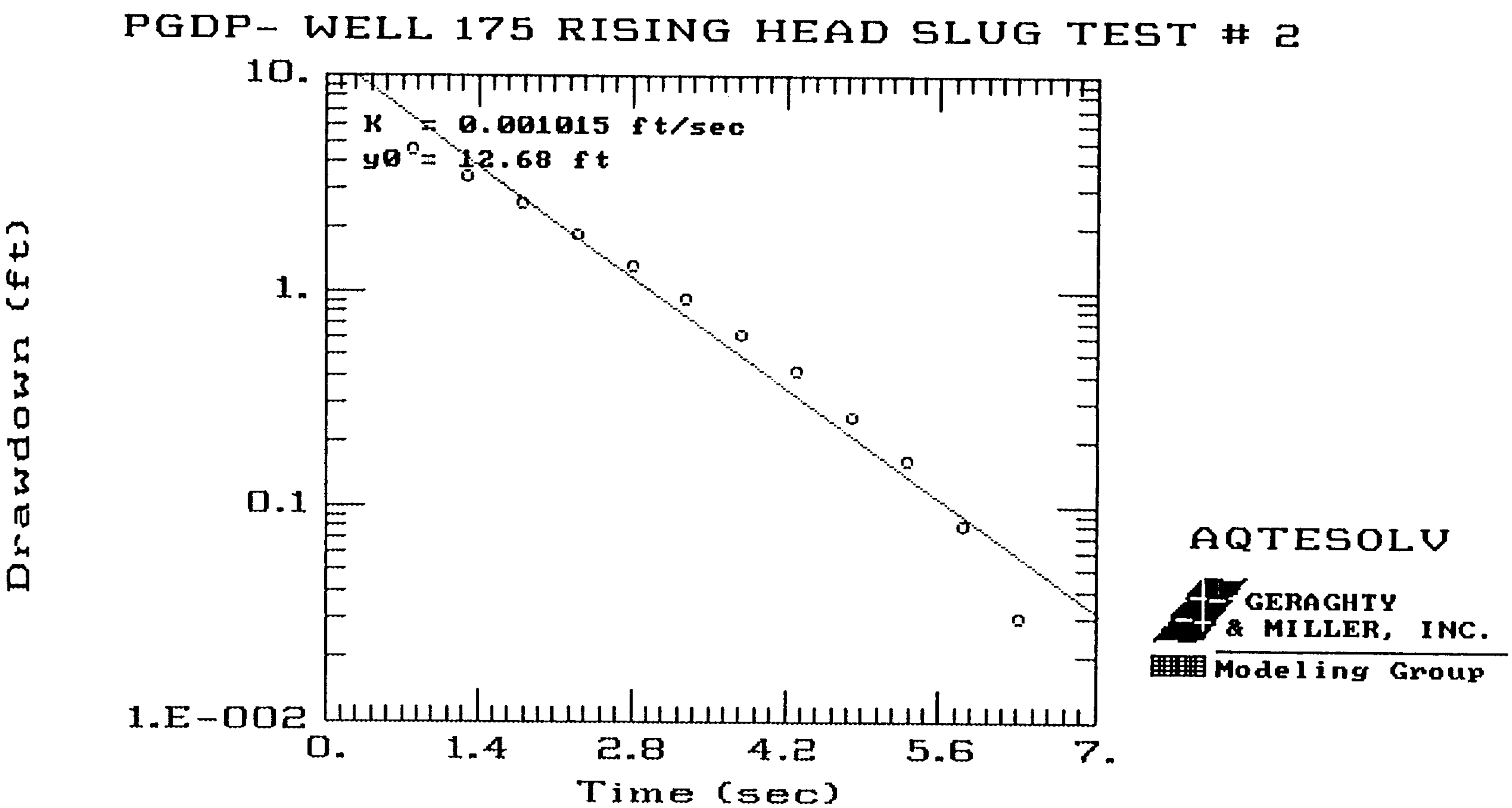

PGDP- WELL 175 RISING HEAD SLUG TEST # 1
K = 0.001024 ft/sec
y0 = 12.54 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
1.4
2.8
4.2
5.6
7.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-37


PGDP- WELL 175 RISING HEAD SLUG TEST # 2
K = 0.001015 ft/sec
y0 = 12.68 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1.4
2.8
4.2
5.6
7.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

. igure A-38

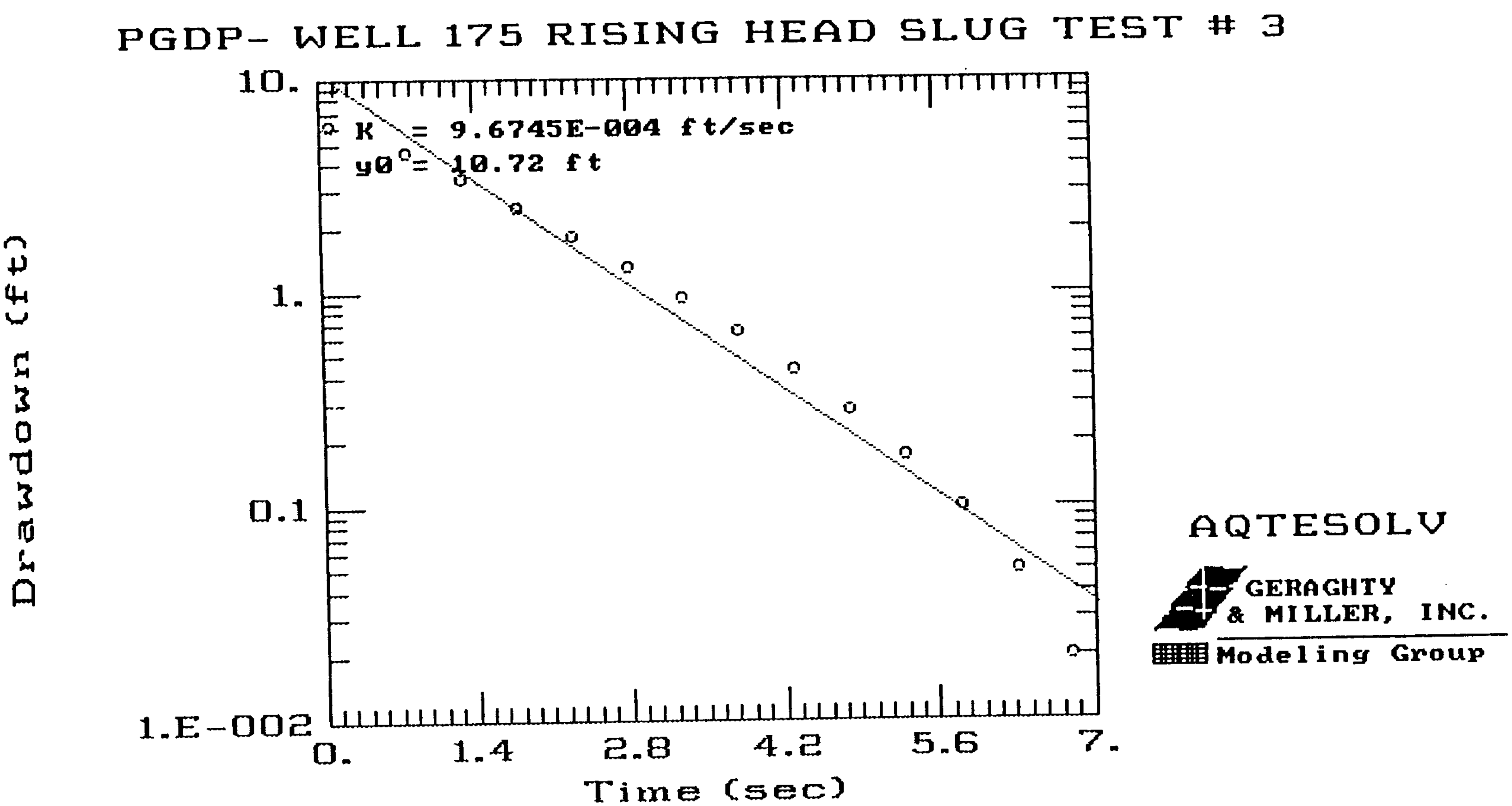

PGDP- WELL 175 RISING HEAD SLUG TEST # 3
K = 9.6745E-004 ft/sec
y0 = 10.72 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1.4
2.8
4.2
5.6
7.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-39

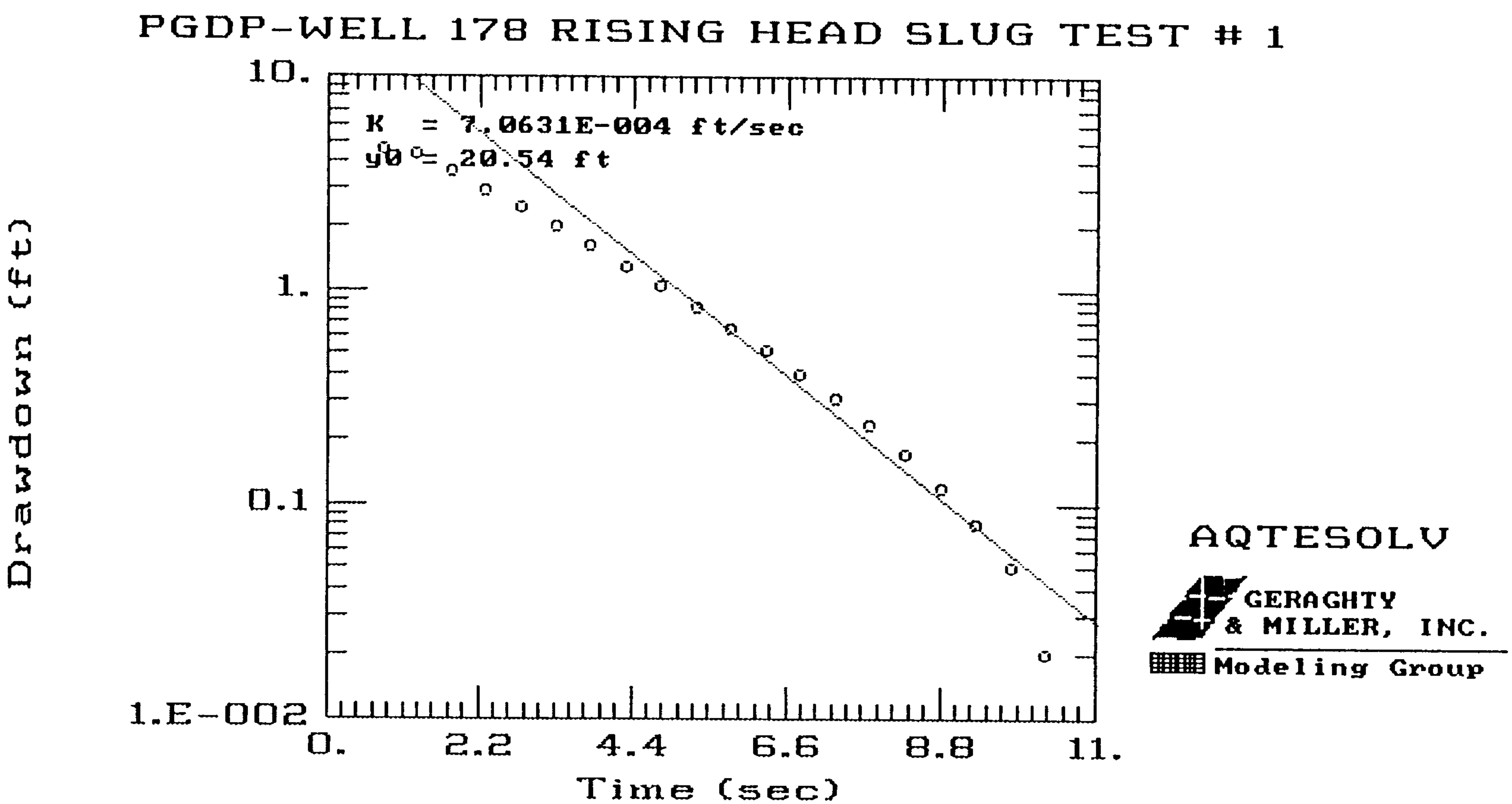

PGDP-WELL 178 RISING HEAD SLUG TEST # 1
K = 7.0631E-004 ft/sec
y0 = 20.54 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
2.2
4.4
6.6
8.8
11.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-40

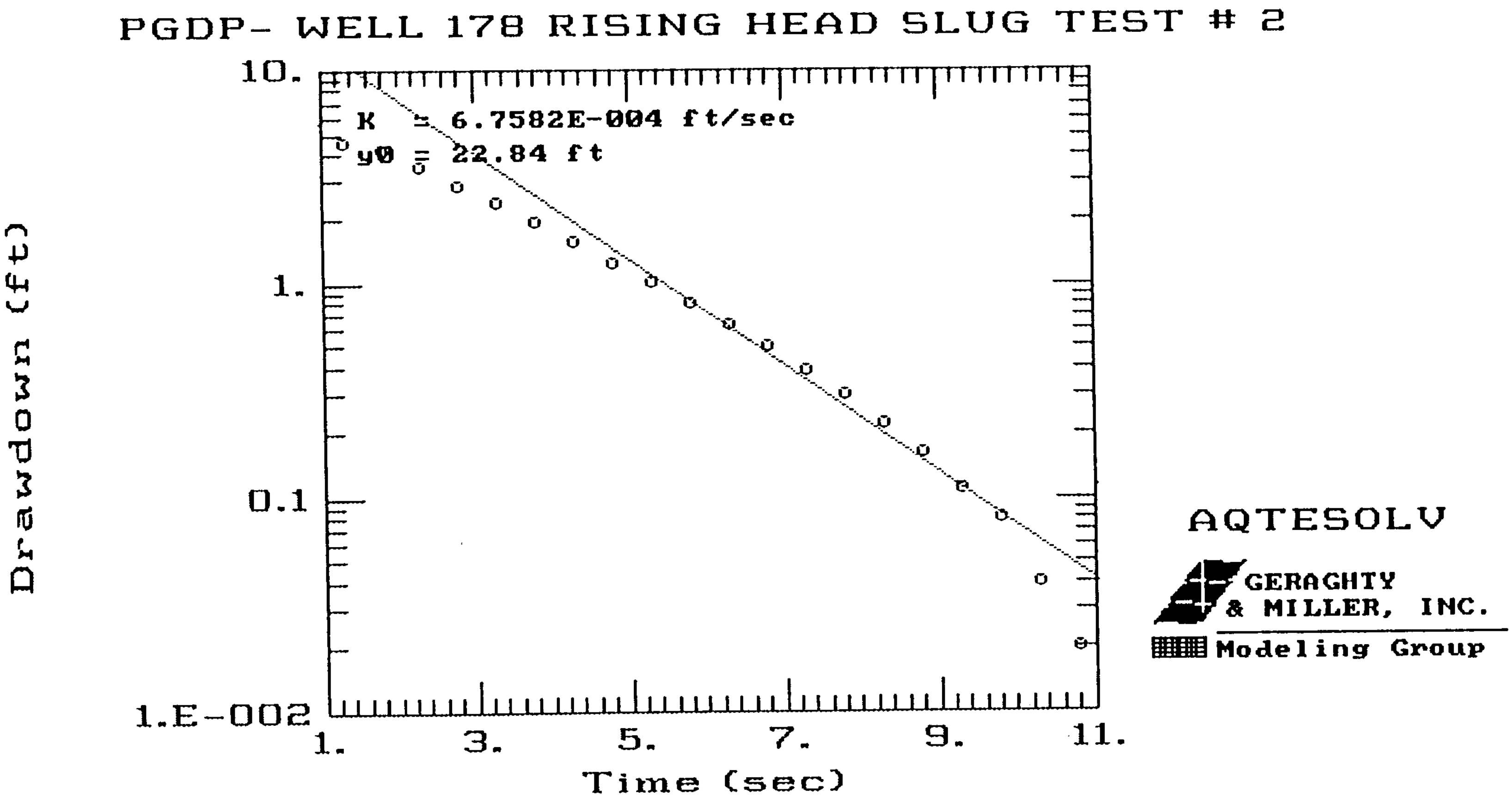

PGDP- WELL 178 RISING HEAD SLUG TEST # 2
K = 6.7582E-004 ft/sec
y0 = 22.84 ft
10.
1.
0.1
1.E-002
1.
3.
5.
7.
9.
11.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-41

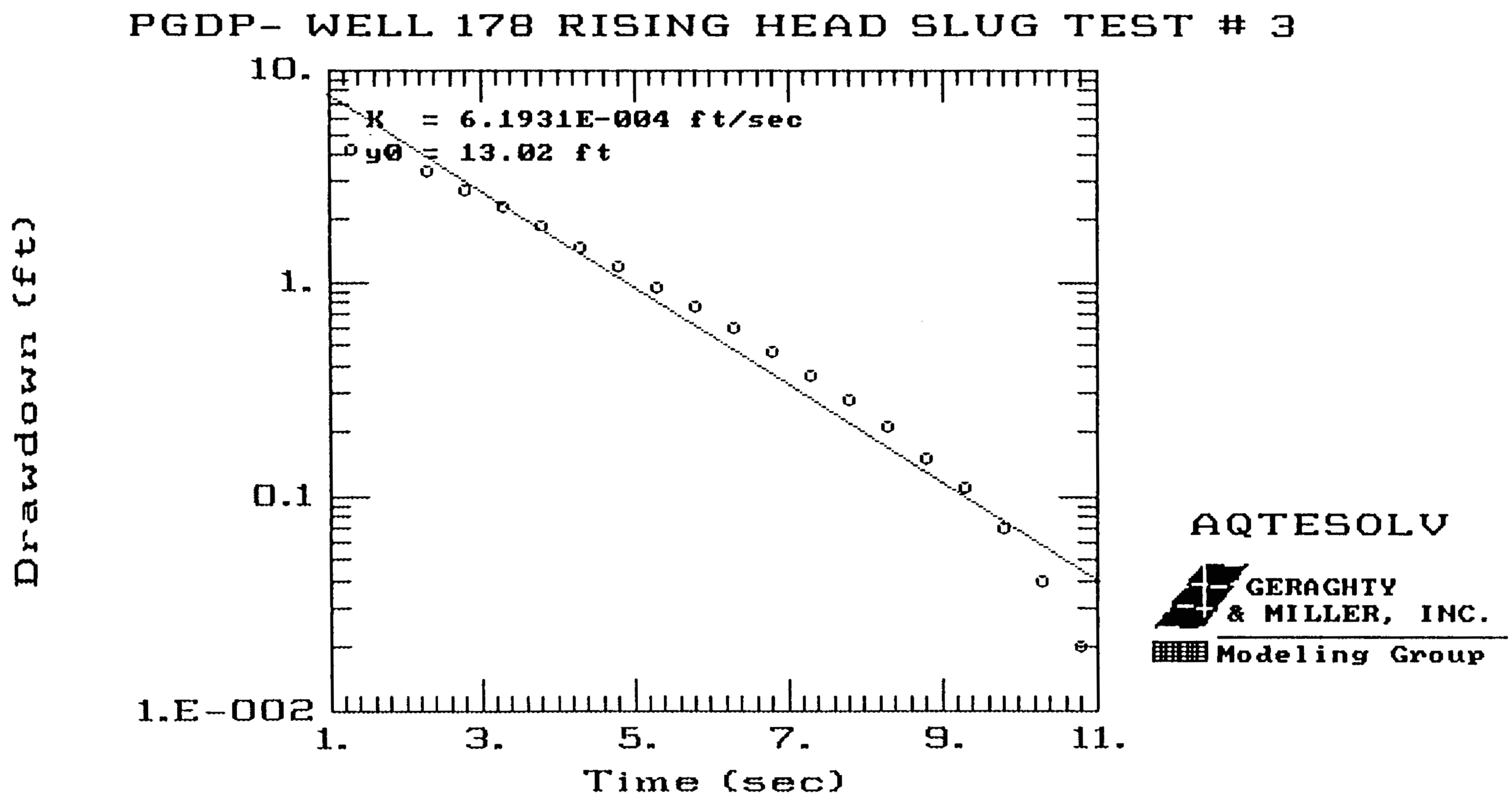

PGDP- WELL 178 RISING HEAD SLUG TEST # 3
K = 6.1931E-004 ft/sec
y0 = 13.02 ft
10.
1.
0.1
1.E-002
1.
3.
5.
7.
9.
11.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-42

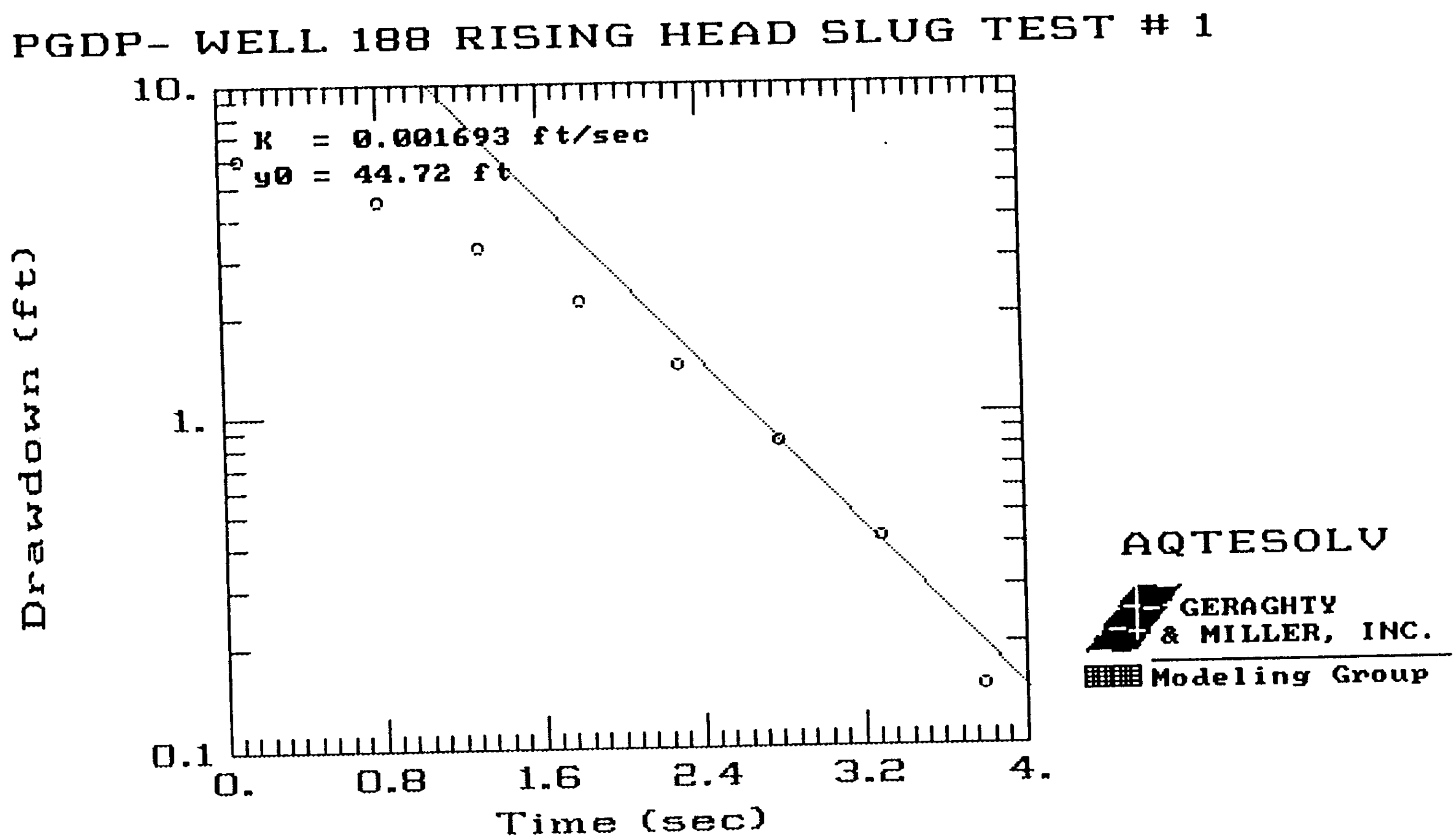

PGDP- WELL 188 RISING HEAD SLUG TEST # 1
K = 0.001693 ft/sec
y0 = 44.72 ft
10.
1.
0.1
Drawdown (ft)
0.
0.8
1.6
2.4
3.2
4.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-43

PGDP- WELL 188 RISING HEAD SLUG TEST # 2

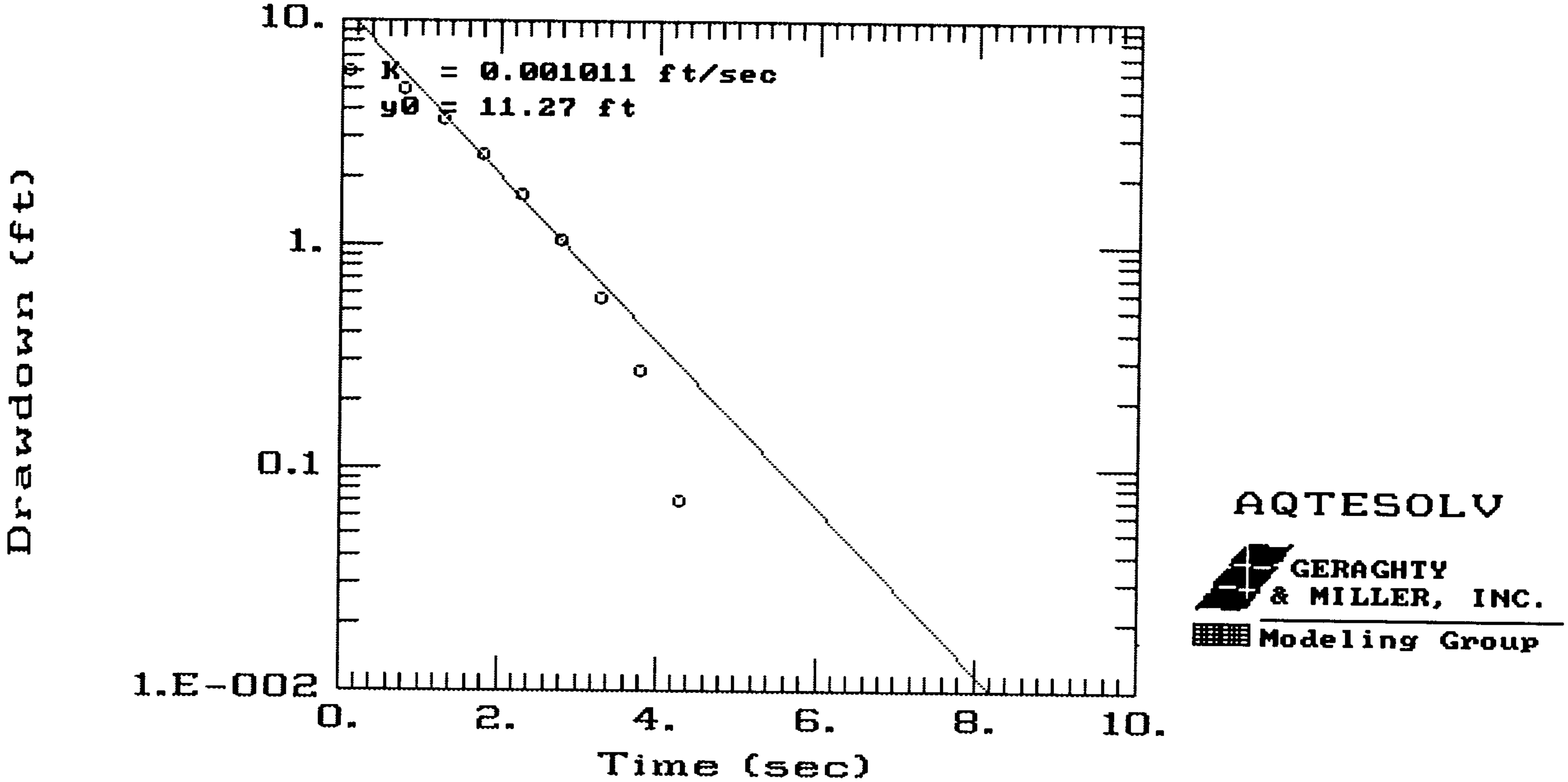


Figure ` 4

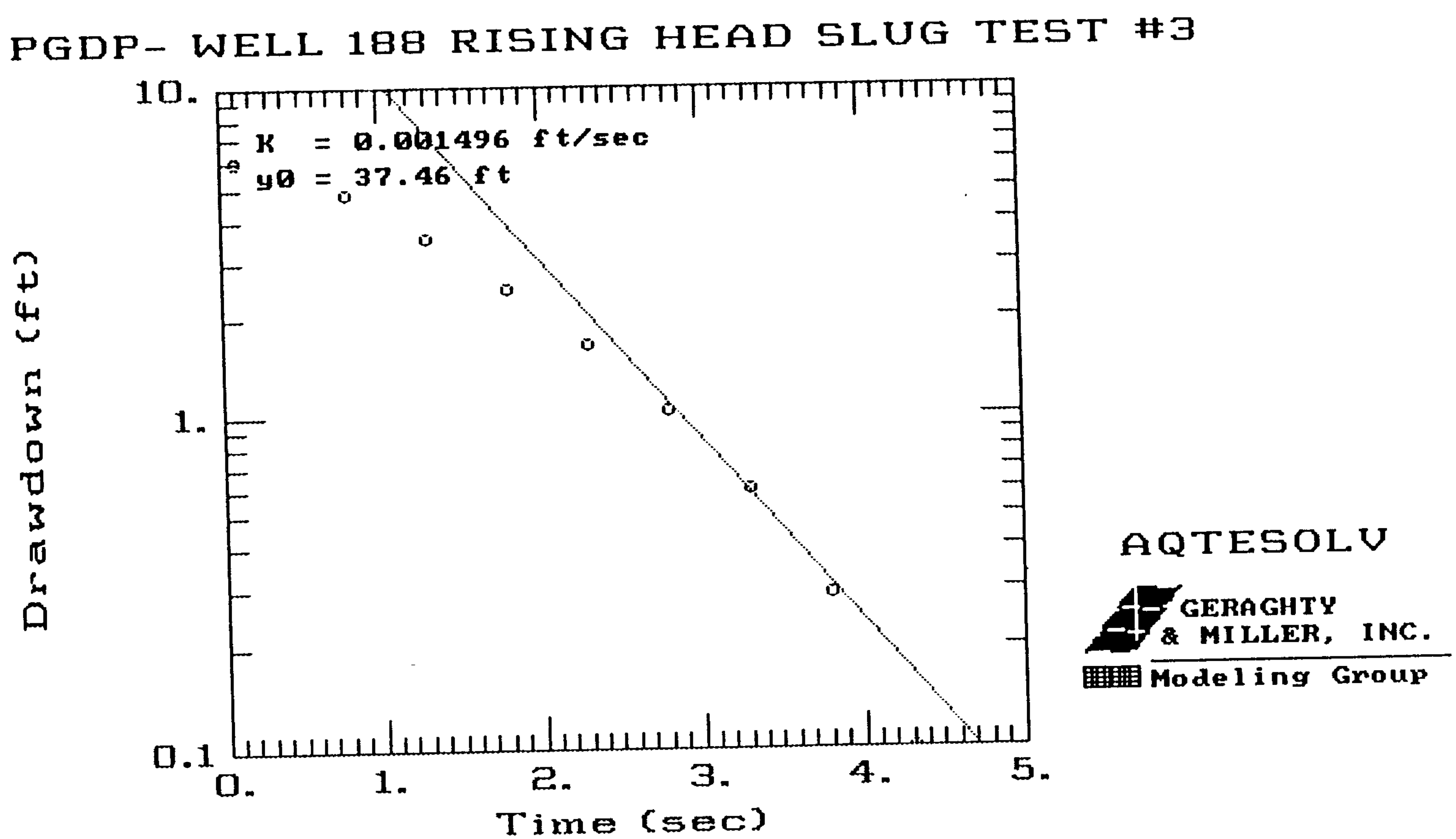

PGDP- WELL 188 RISING HEAD SLUG TEST #3
K = 0.001496 ft/sec
y0 = 37.46 ft
10.
1.
0.1
0.
1.
2.
3.
4.
5.
Drawdown (ft)
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-45

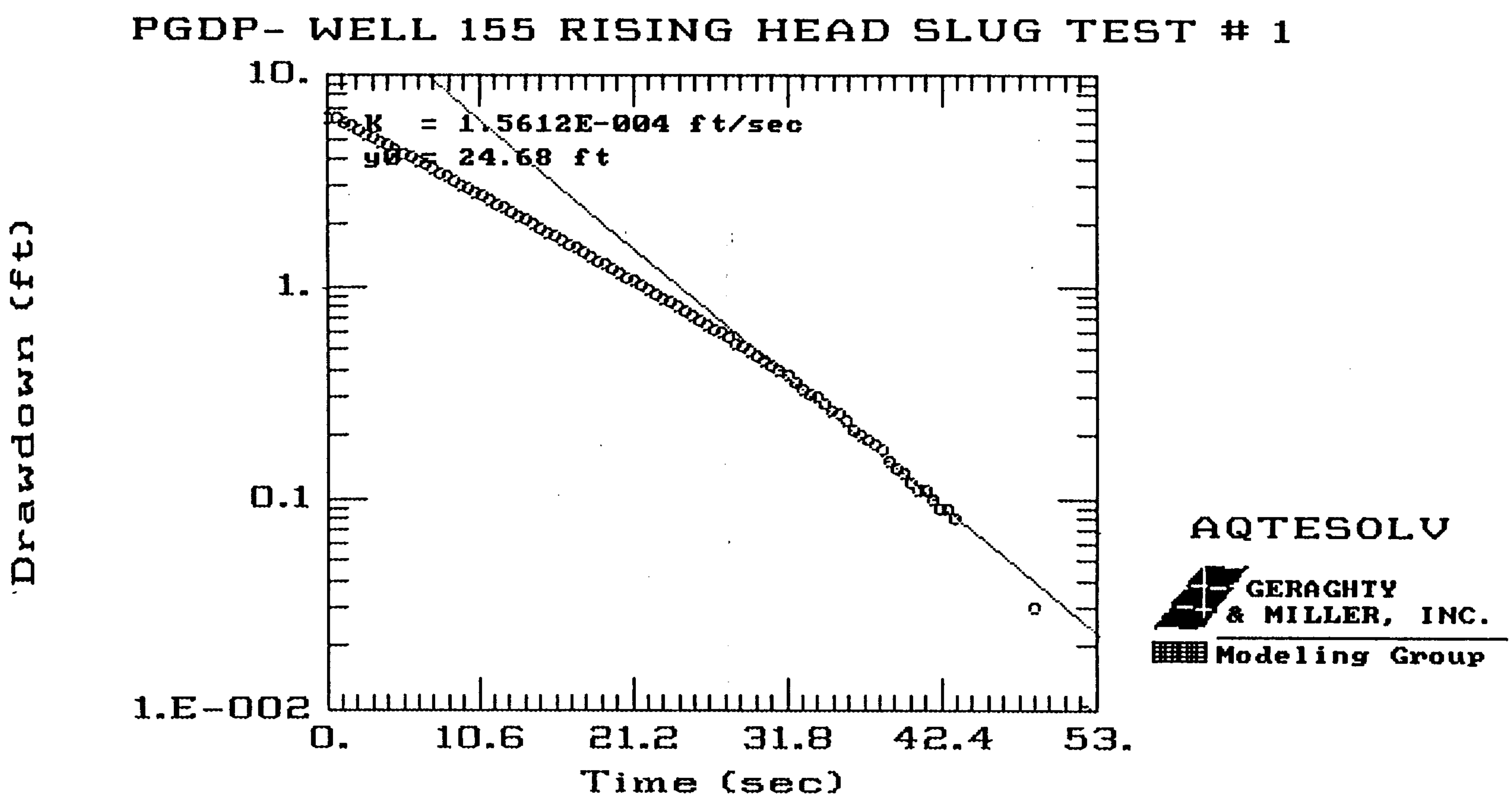

PGDP- WELL 155 RISING HEAD SLUG TEST # 1
K = 1.5612E-004 ft/sec
y0 = 24.68 ft
10.
1.
0.1
1.E-002
0.
10.6
21.2
31.8
42.4
53.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-46

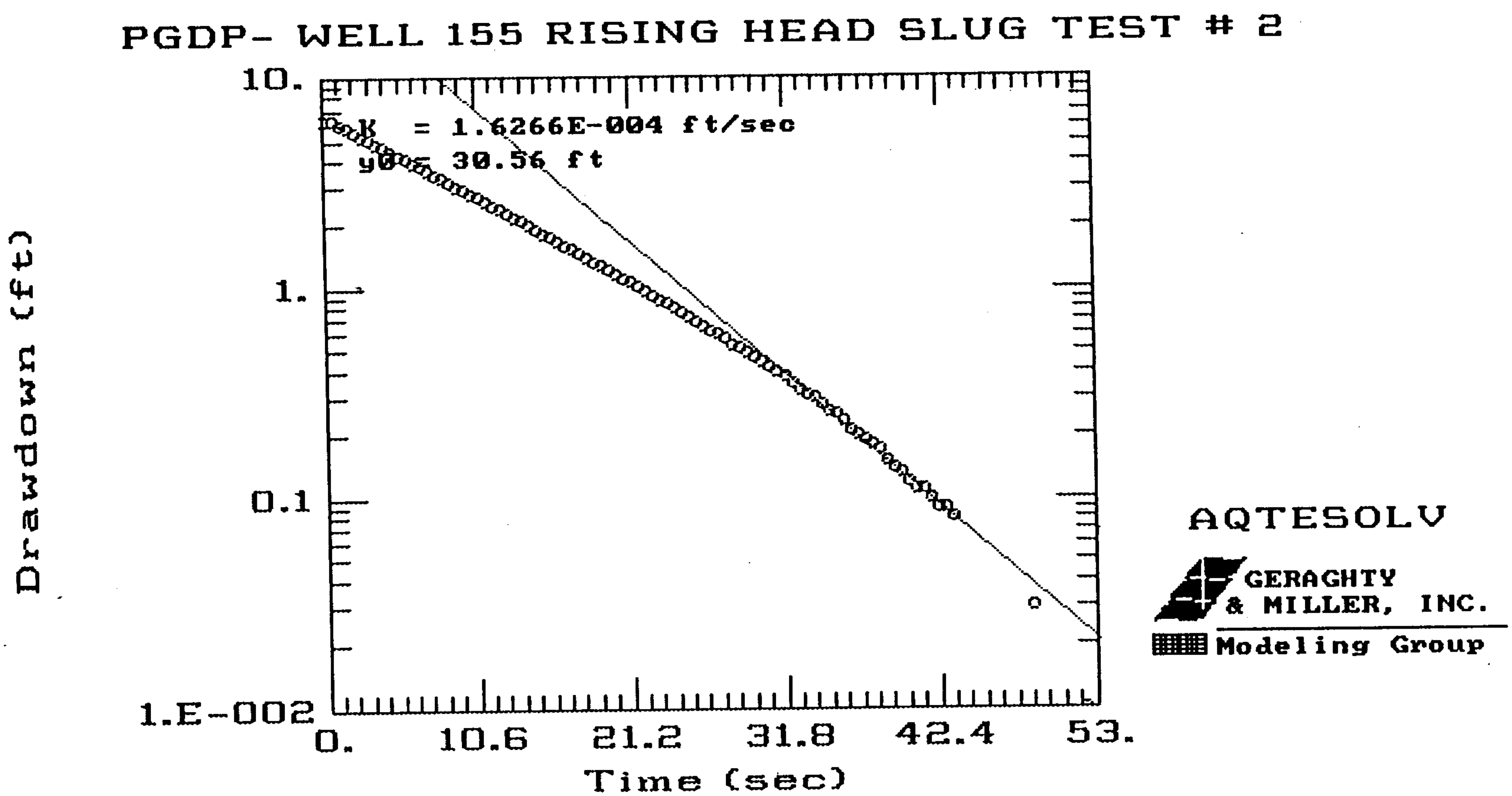

PGDP- WELL 155 RISING HEAD SLUG TEST # 2
K = 1.6266E-004 ft/sec
y0 = 30.56 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
10.6
21.2
31.8
42.4
53.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure A-47

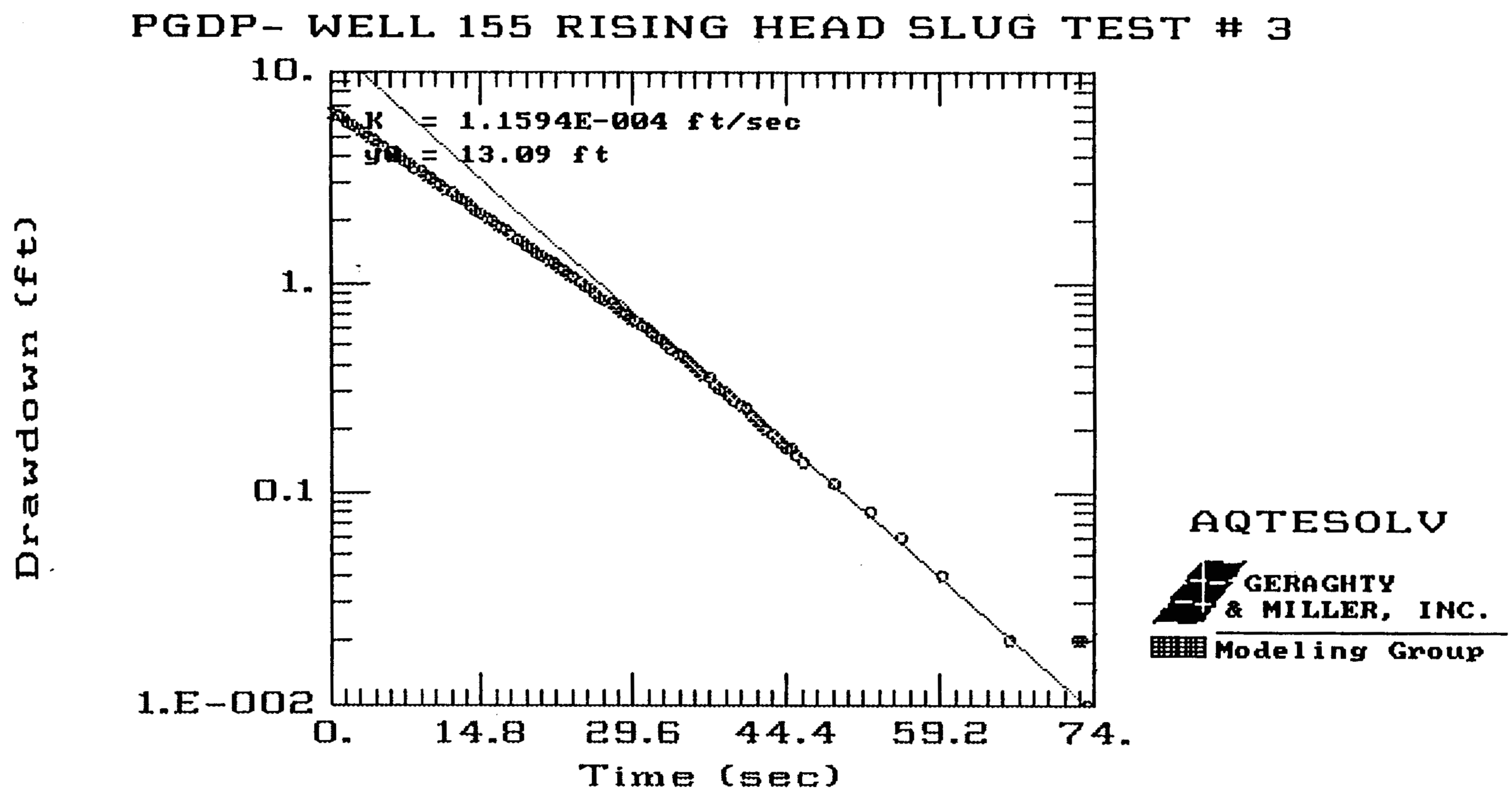

PGDP- WELL 155 RISING HEAD SLUG TEST # 3
K = 1.1594E-004 ft/sec
y0 = 13.09 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
14.8
29.6
44.4
59.2
74.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure 48

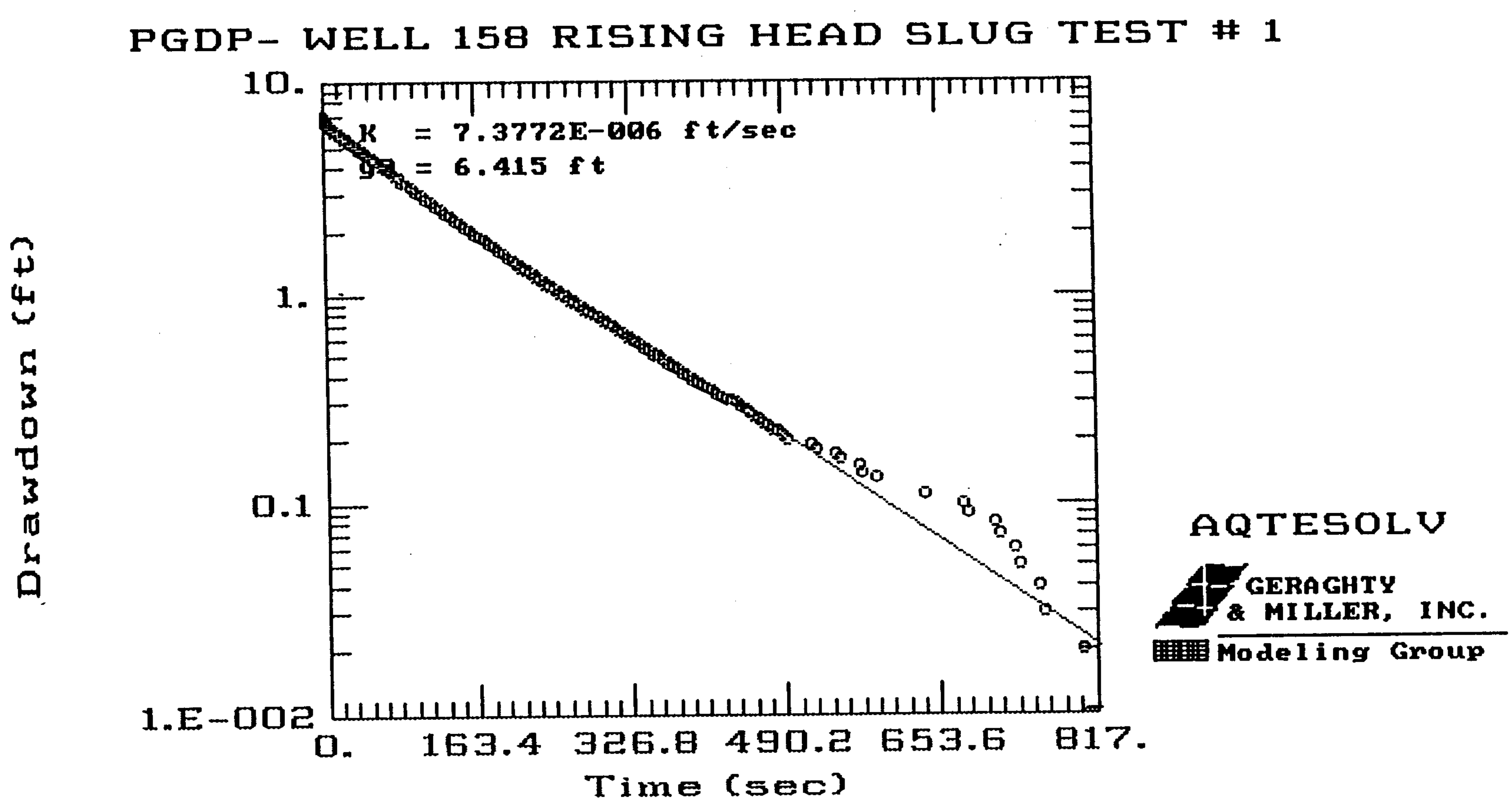
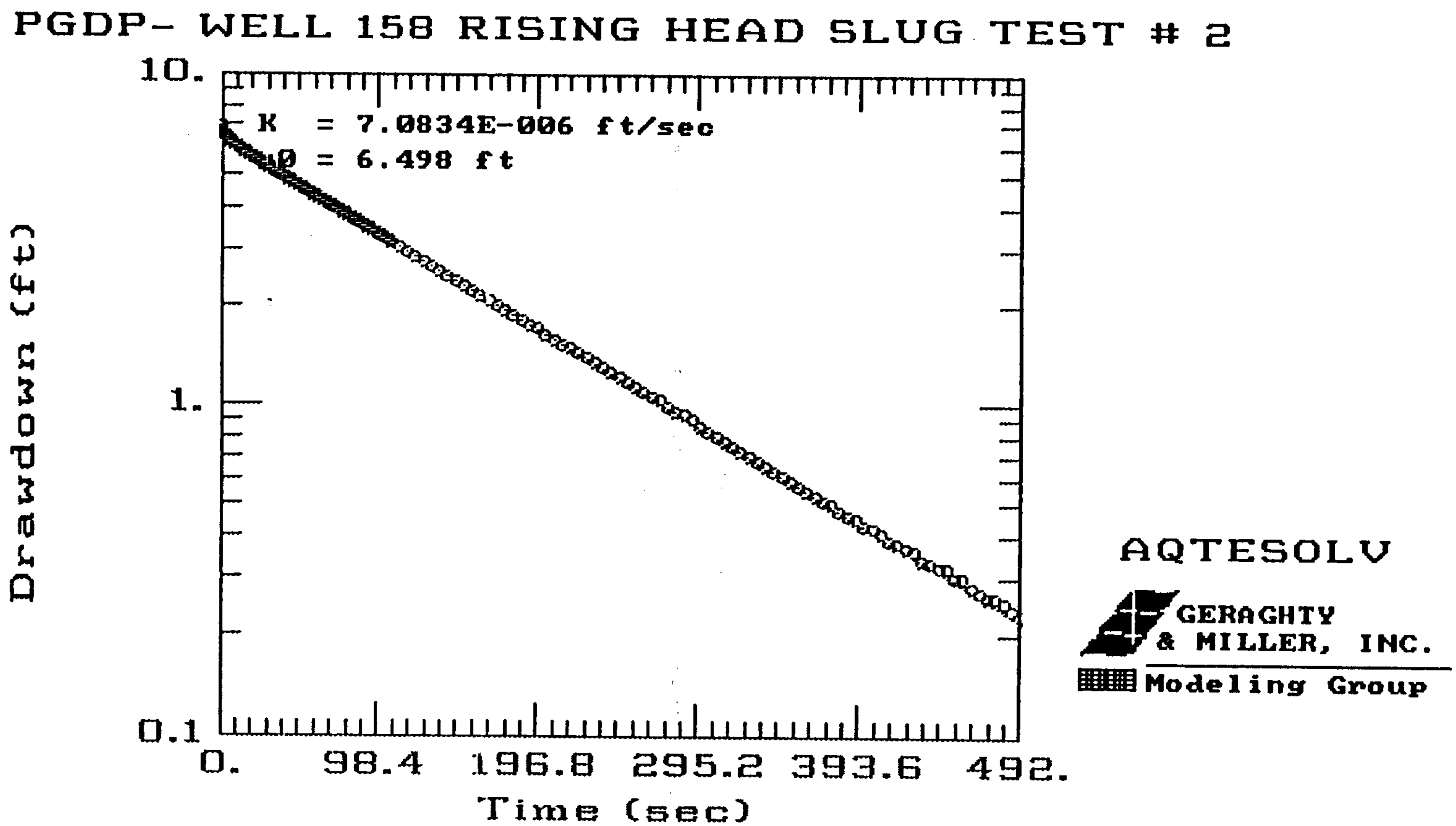

PGDP- WELL 158 RISING HEAD SLUG TEST # 1
K = 7.3772E-006 ft/sec
y0 = 6.415 ft
10.
1.
0.1
1.E-002
0.
163.4
326.8
490.2
653.6
817.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure A-49

Unconfined



PGDP- WELL 158 RISING HEAD SLUG TEST # 2
K = 7.0834E-006 ft/sec
y0 = 6.498 ft
10.
1.
0.1
Drawdown (ft)
0.
98.4
196.8
295.2
393.6
492.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Attachment B
STAGE B WELLS

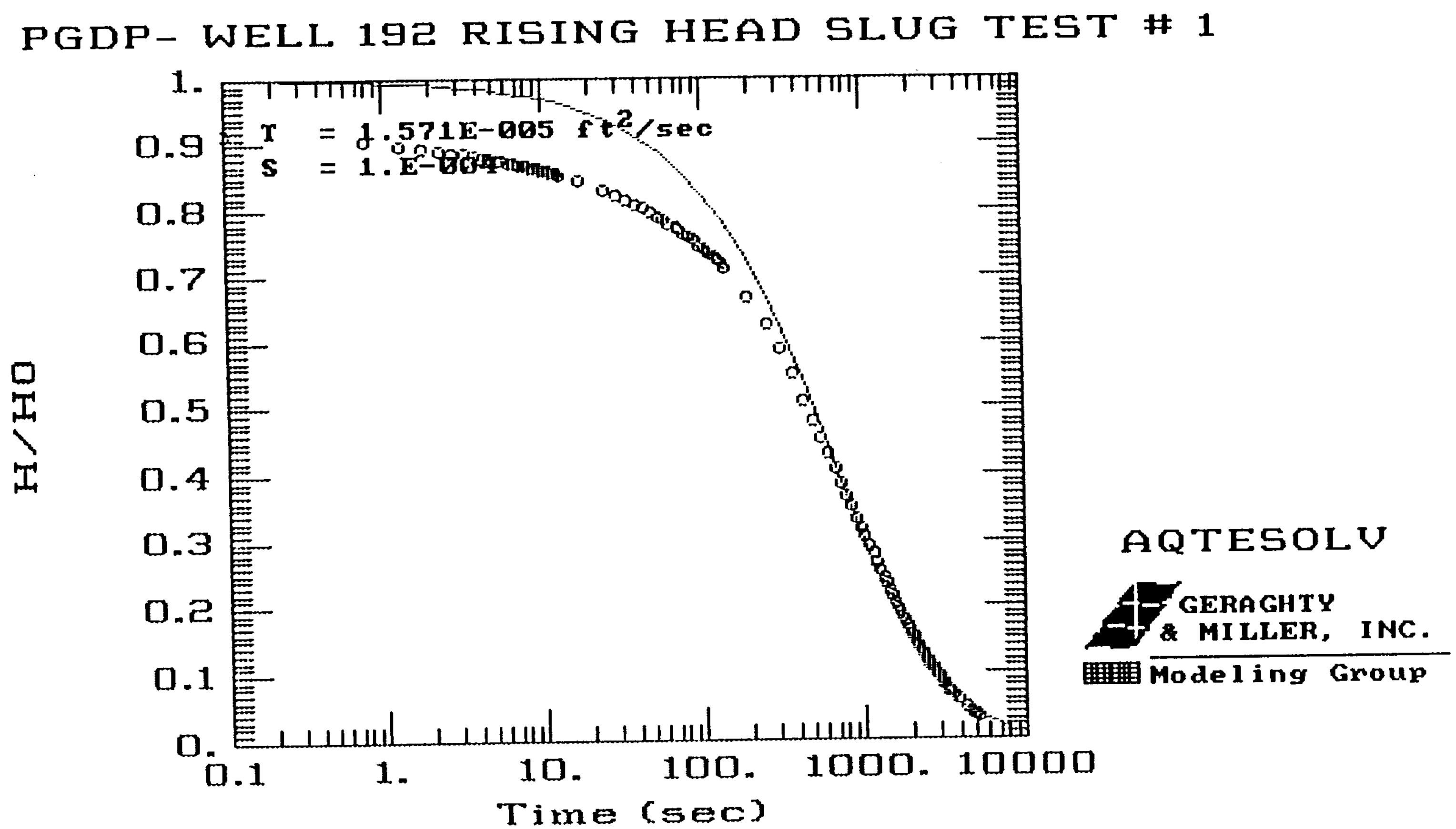
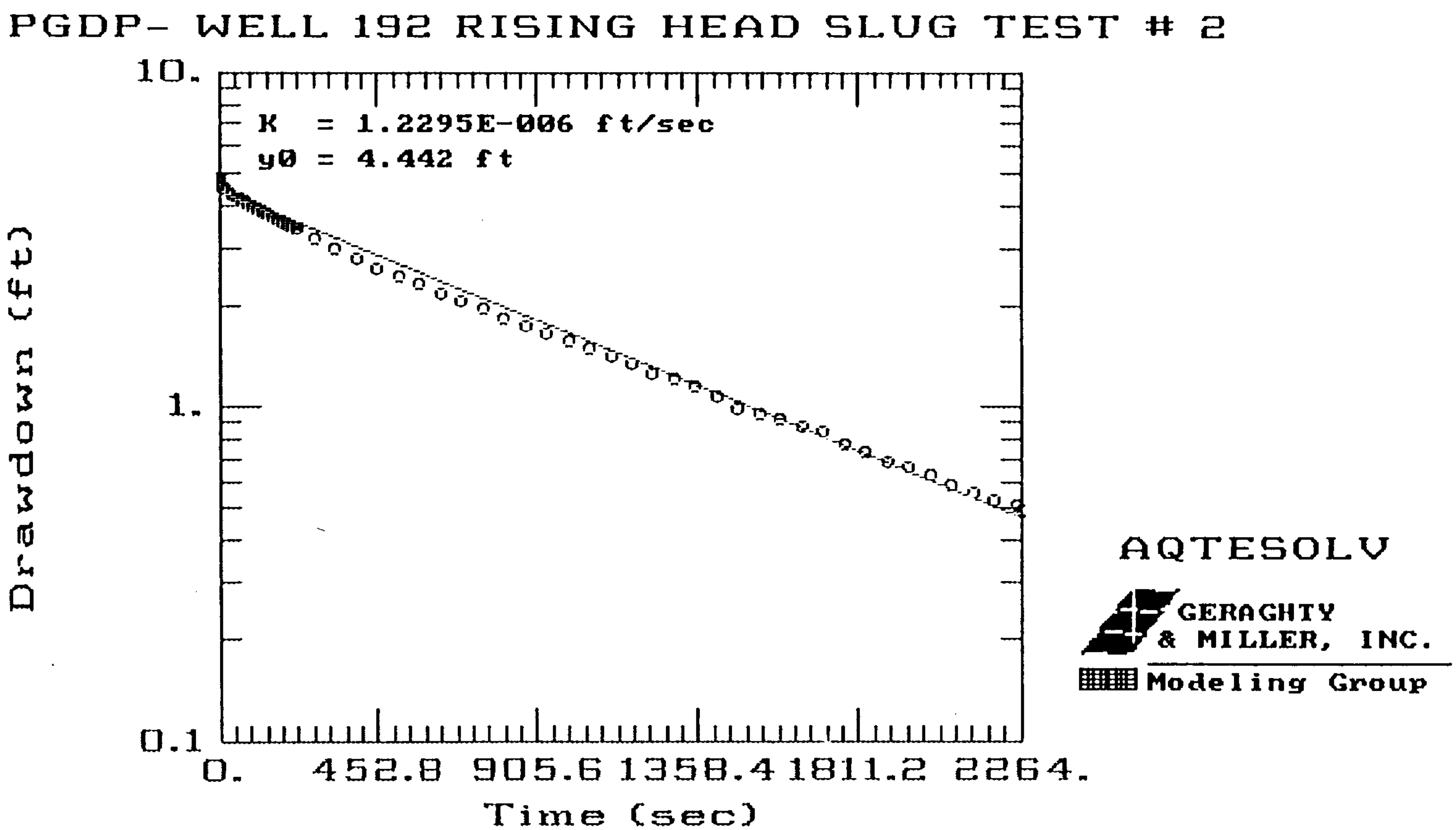

PGDP- WELL 192 RISING HEAD SLUG TEST # 1
T = 1.571E-005 ft²/sec
S = 1.E-004
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
10000
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-1


PGDP- WELL 192 RISING HEAD SLUG TEST # 2
K = 1.2295E-006 ft/sec
y0 = 4.442 ft
10.
1.
0.1
Drawdown (ft)
0.
452.8
905.6
1358.4
1811.2
2264.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

_jure B-2

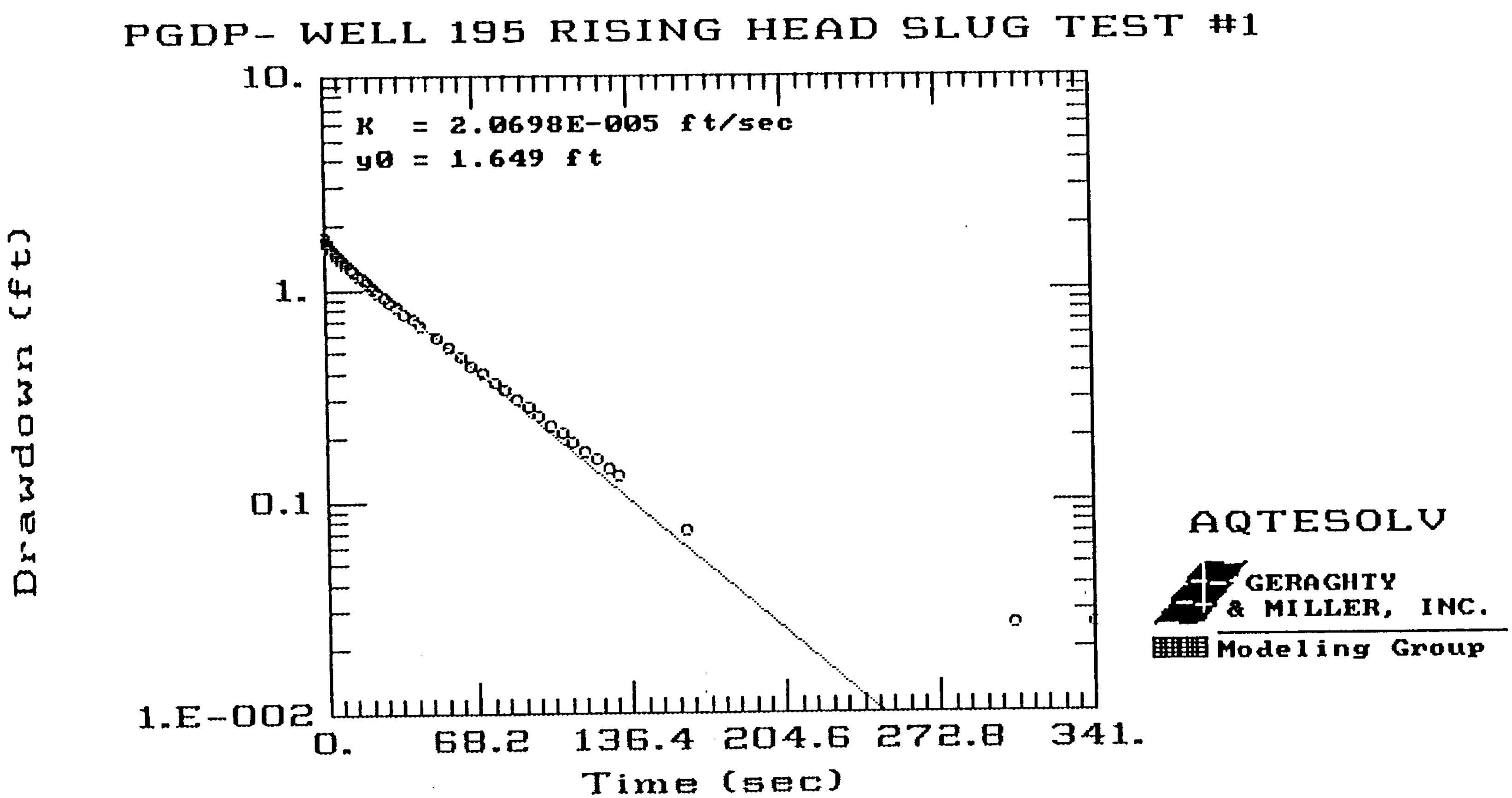
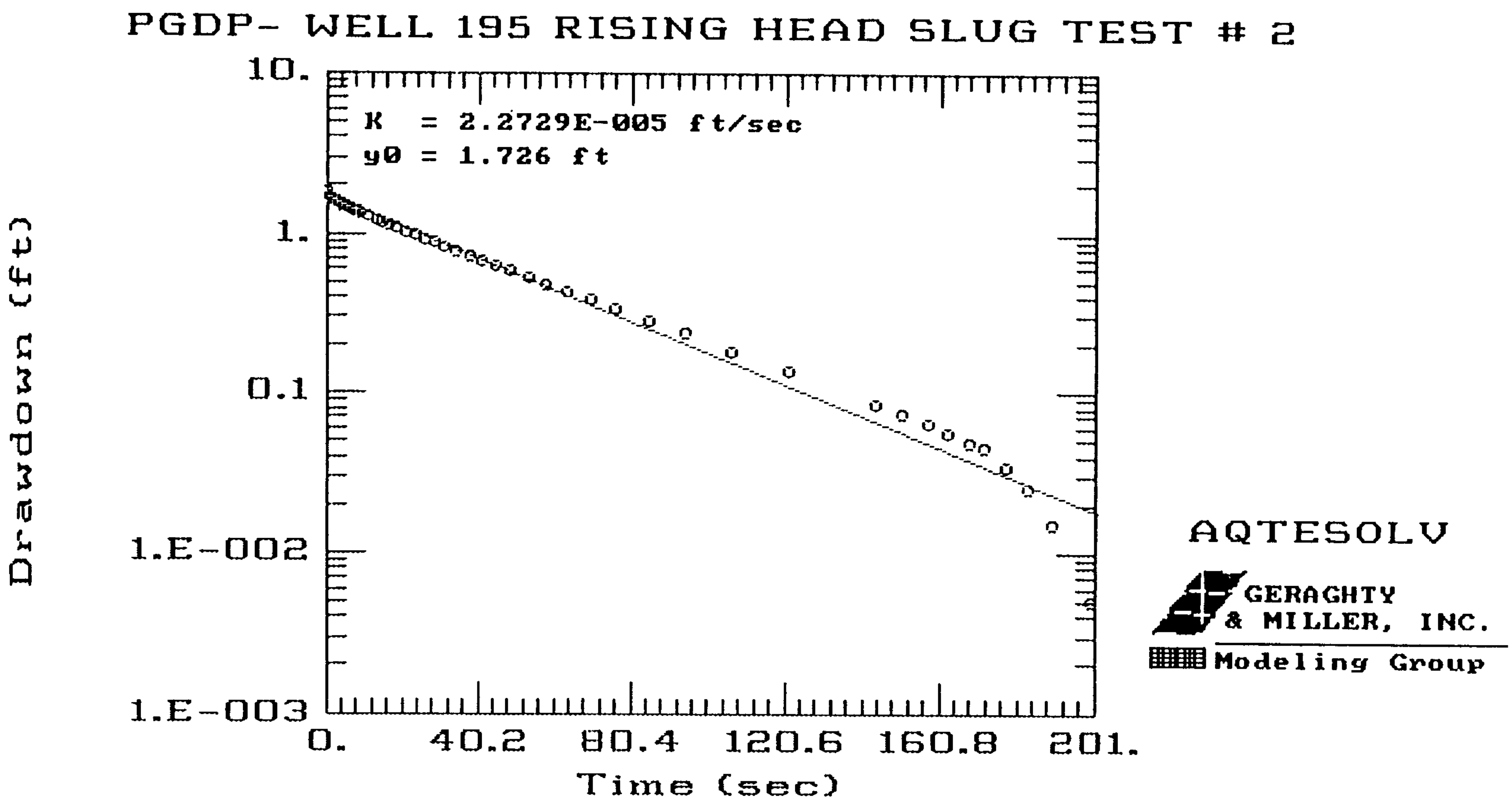
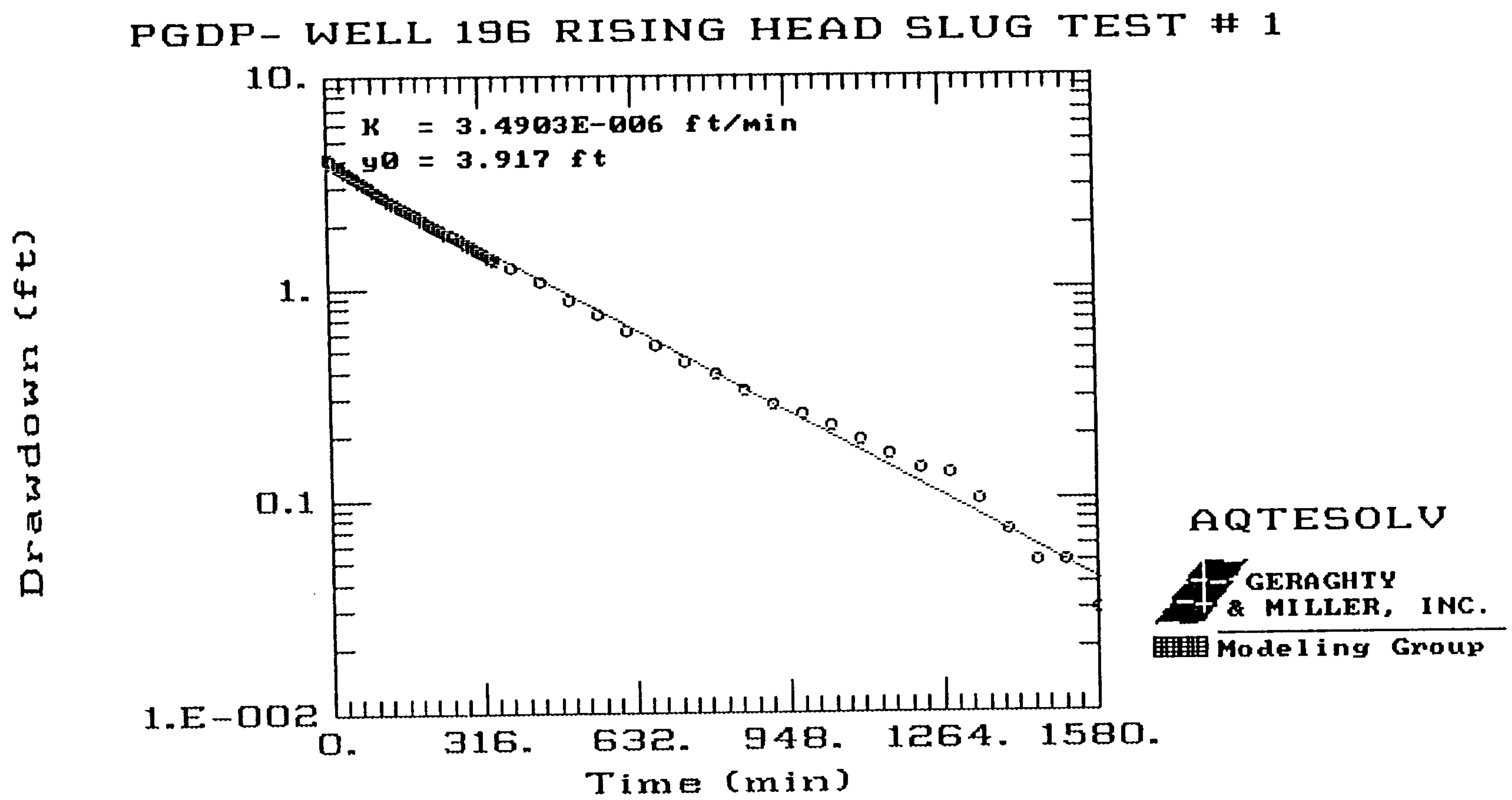

PGDP- WELL 195 RISING HEAD SLUG TEST #1
K = 2.0698E-005 ft/sec
y0 = 1.649 ft
10.
1.
0.1
1.E-002
0.
68.2
136.4
204.6
272.8
341.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

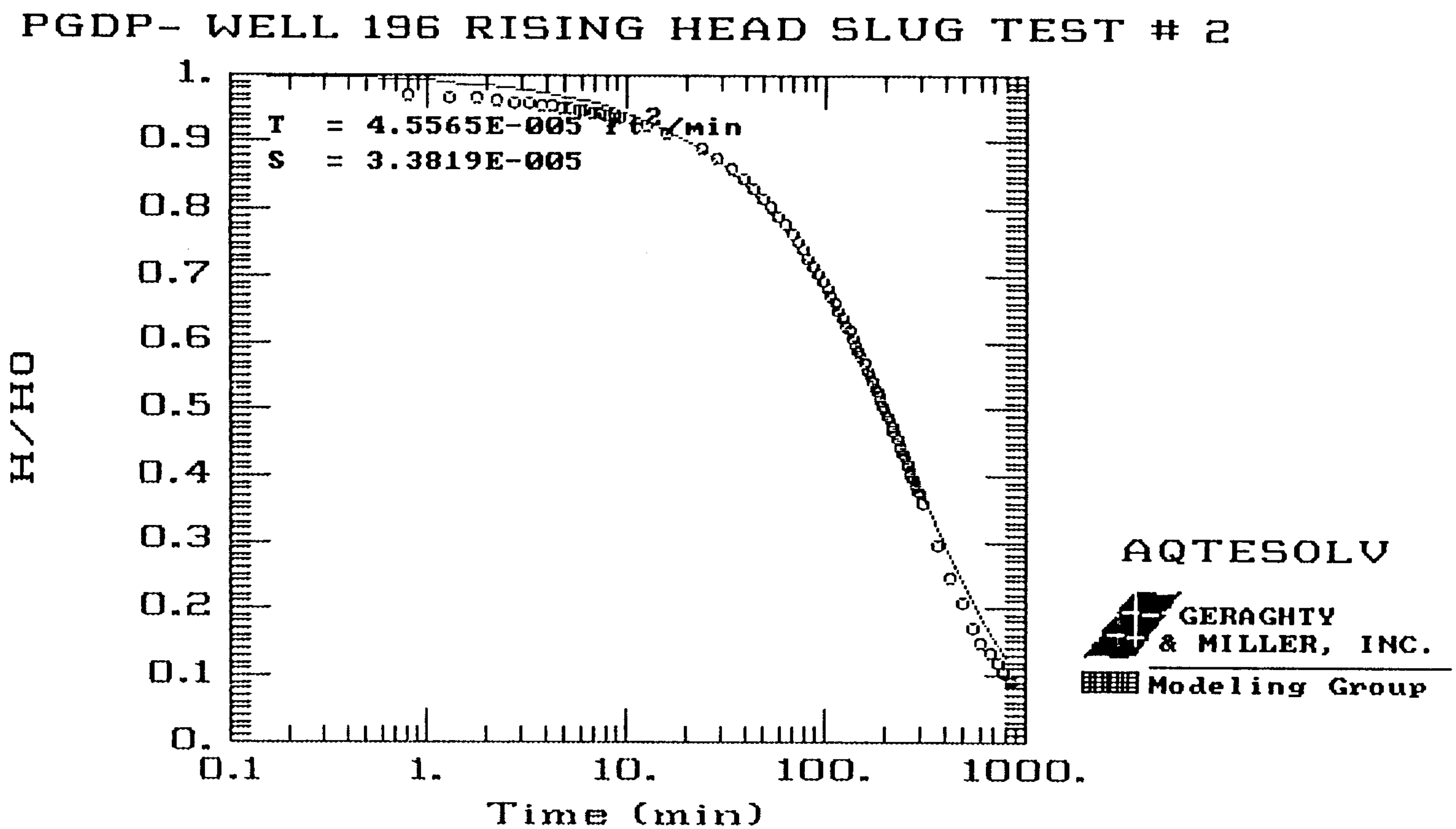
Figure B-3


PGDP- WELL 195 RISING HEAD SLUG TEST # 2
K = 2.2729E-005 ft/sec
y0 = 1.726 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
1.E-003
0.
40.2
80.4
120.6
160.8
201.
Time (sec)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group



PGDP- WELL 196 RISING HEAD SLUG TEST # 1
K = 3.4903E-006 ft/min
y0 = 3.917 ft
10.
1.
0.1
1.E-002
0.
316.
632.
948.
1264.
1580.
Time (min)
Drawdown (ft)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure B-5


PGDP- WELL 196 RISING HEAD SLUG TEST # 2
T = 4.5565E-005 ft^2/min
S = 3.3819E-005
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
Time (min)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

. .gure B-6

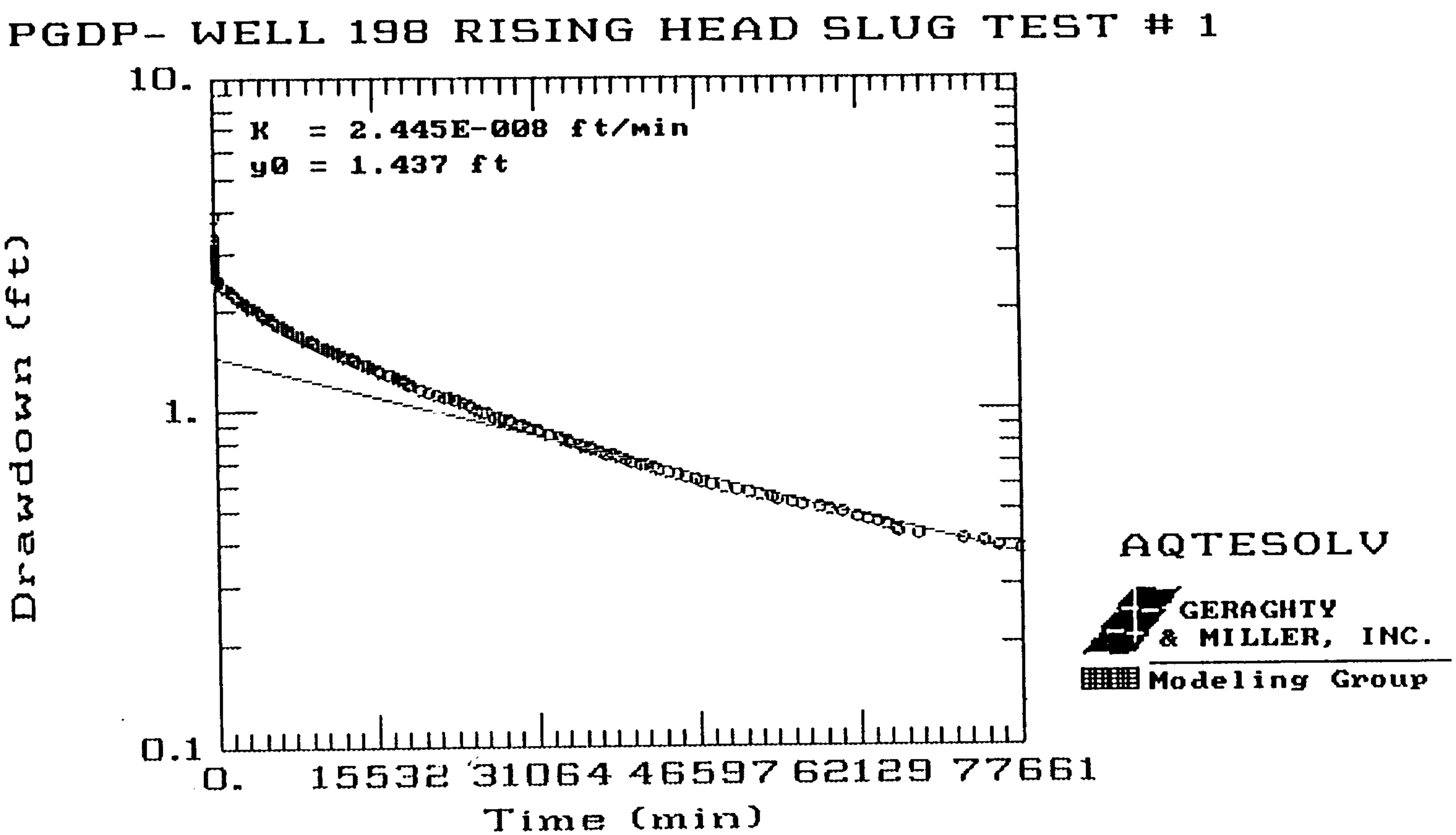
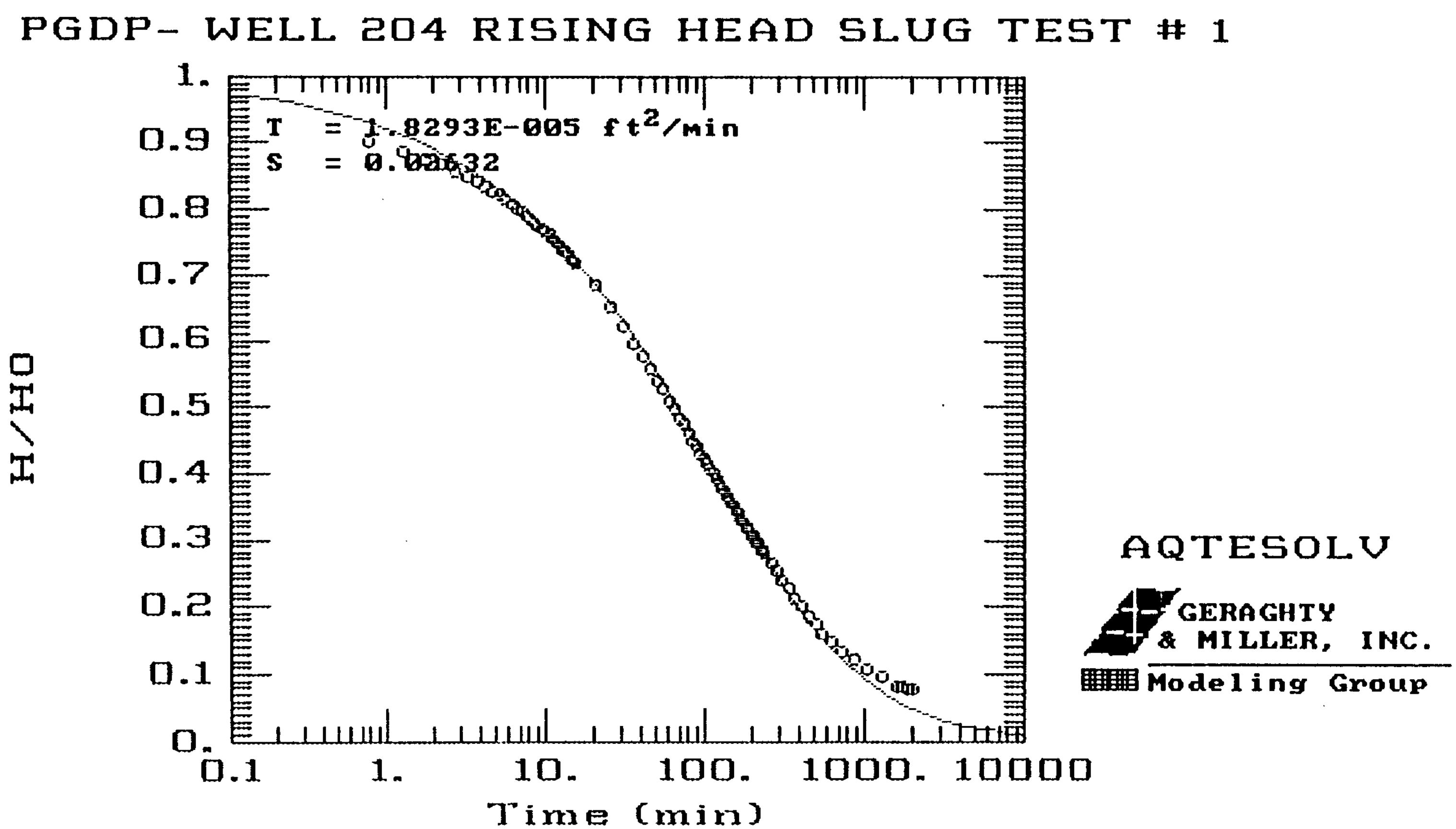
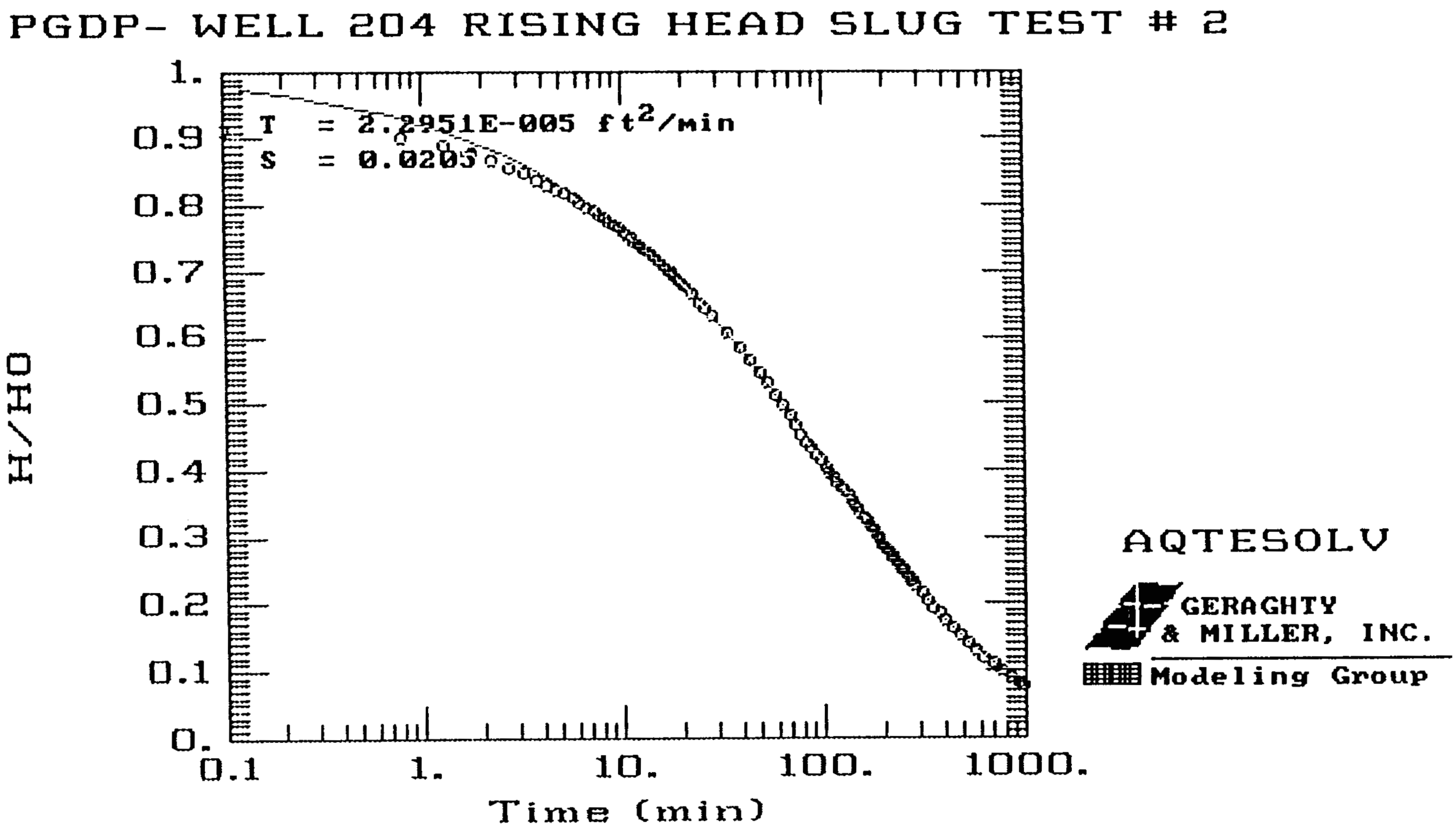

PGDP- WELL 198 RISING HEAD SLUG TEST # 1
K = 2.445E-008 ft/min
y0 = 1.437 ft
10.
1.
0.1
Drawdown (ft)
0.
15532
31064
46597
62129
77661
Time (min)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure B-7



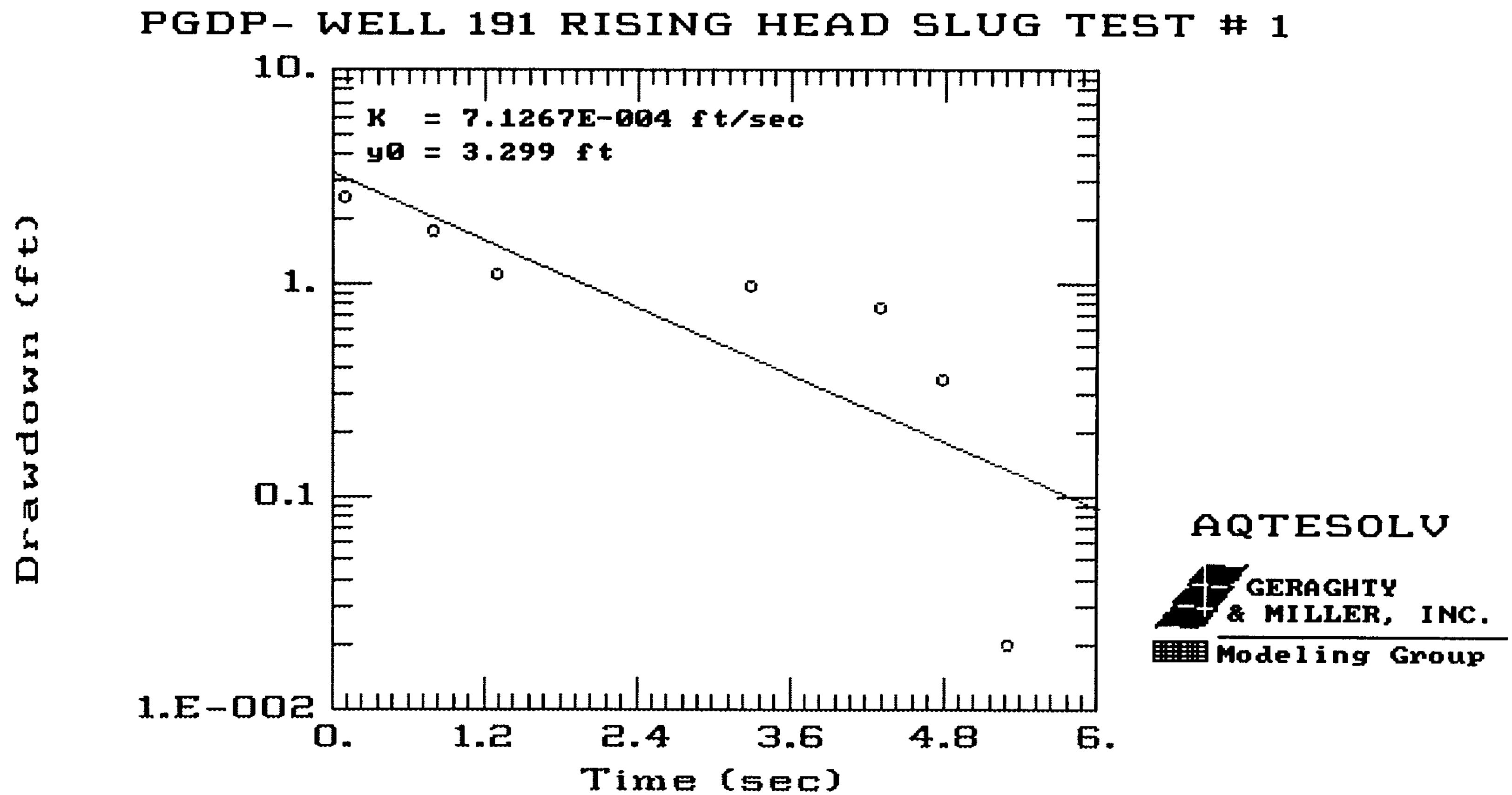
PGDP- WELL 204 RISING HEAD SLUG TEST # 1
T = 1.8293E-005 ft²/min
S = 0.02632
H/HO
Time (min)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
10000
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

Figure B-8



PGDP- WELL 204 RISING HEAD SLUG TEST # 2
T = 2.2951E-005 ft^2/min
S = 0.0205
H/HO
Time (min)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
1000.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-9


PGDP- WELL 191 RISING HEAD SLUG TEST # 1
K = 7.1267E-004 ft/sec
y0 = 3.299 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1.2
2.4
3.6
4.8
6.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figı -10

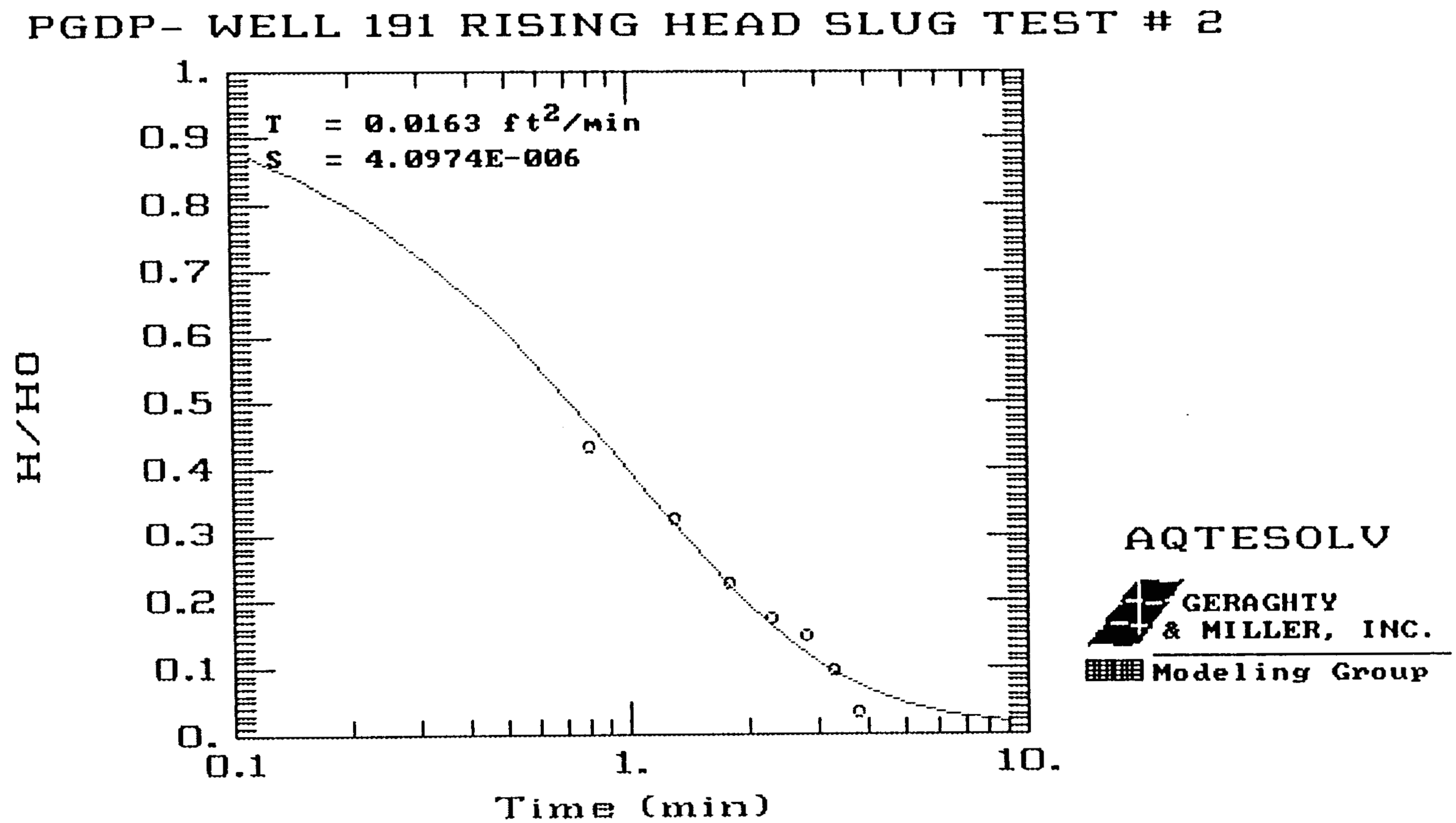
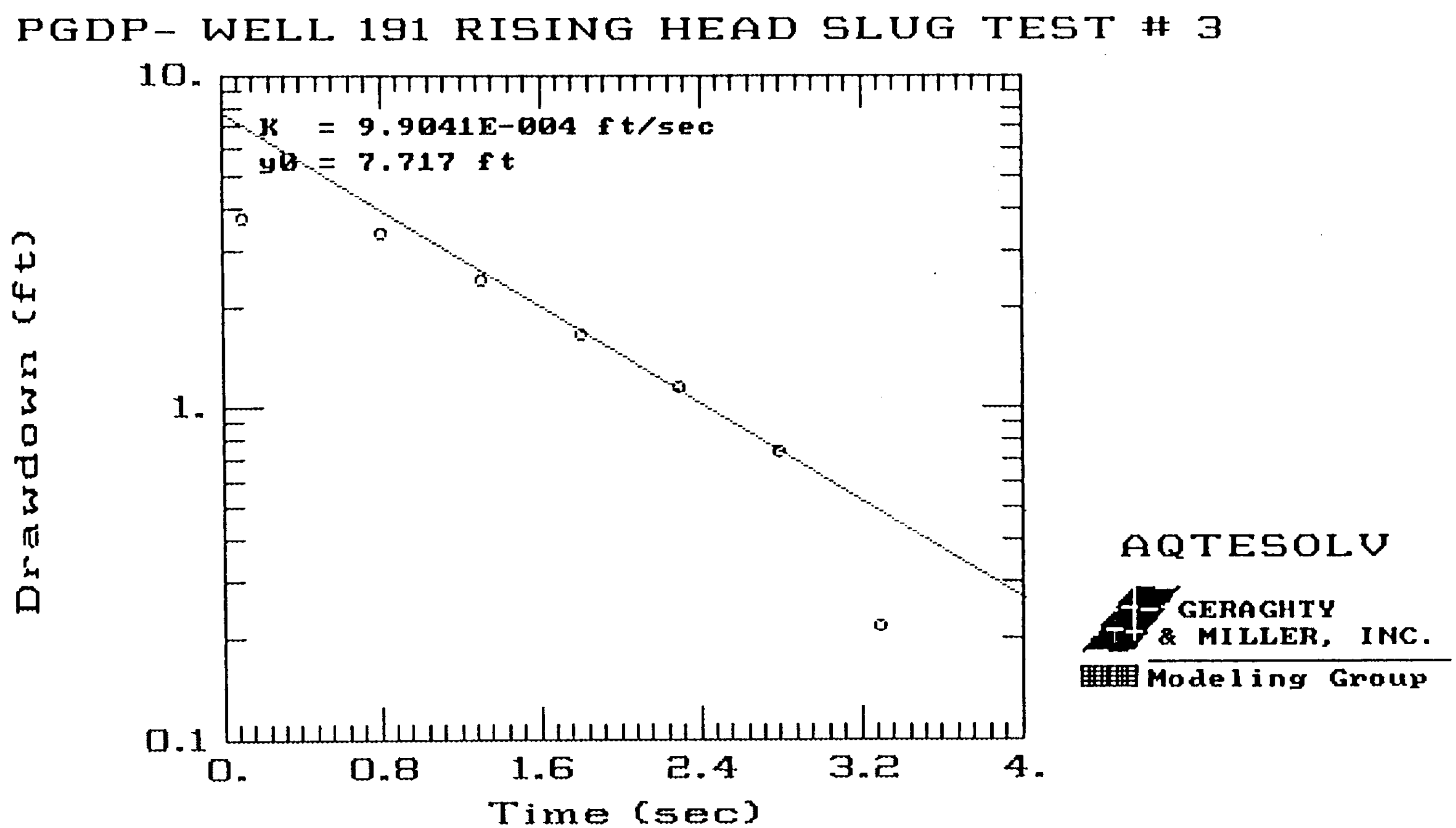
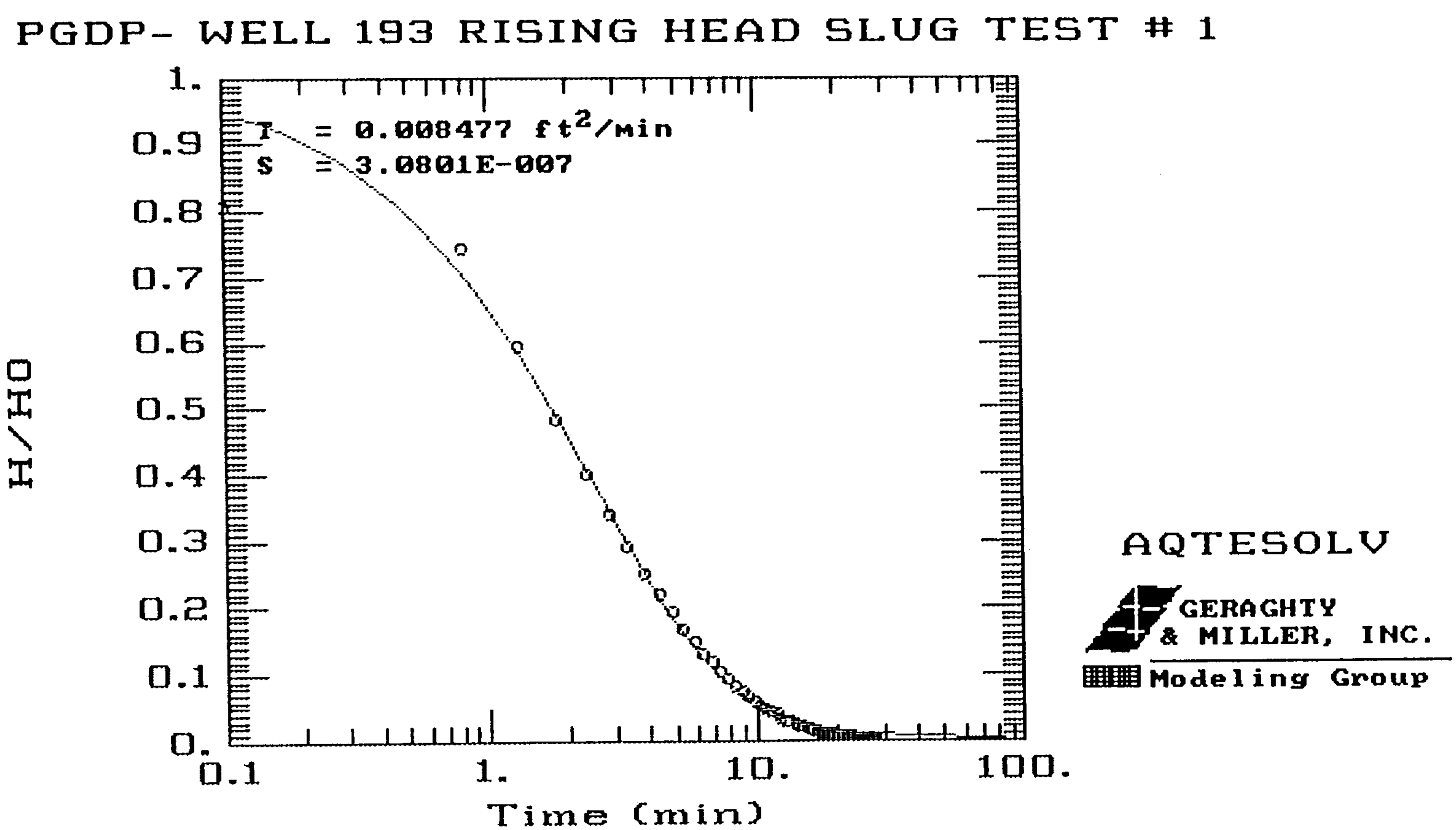

PGDP- WELL 191 RISING HEAD SLUG TEST # 2
T = 0.0163 ft²/min
S = 4.0974E-006
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
Time (min)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-11



PGDP- WELL 191 RISING HEAD SLUG TEST # 3
K = 9.9041E-004 ft/sec
y0 = 7.717 ft
10.
1.
0.1
Drawdown (ft)
0.
0.8
1.6
2.4
3.2
4.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-12



PGDP- WELL 193 RISING HEAD SLUG TEST # 1
T = 0.008477 ft²/min
S = 3.0801E-007
H/HO
Time (min)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-13

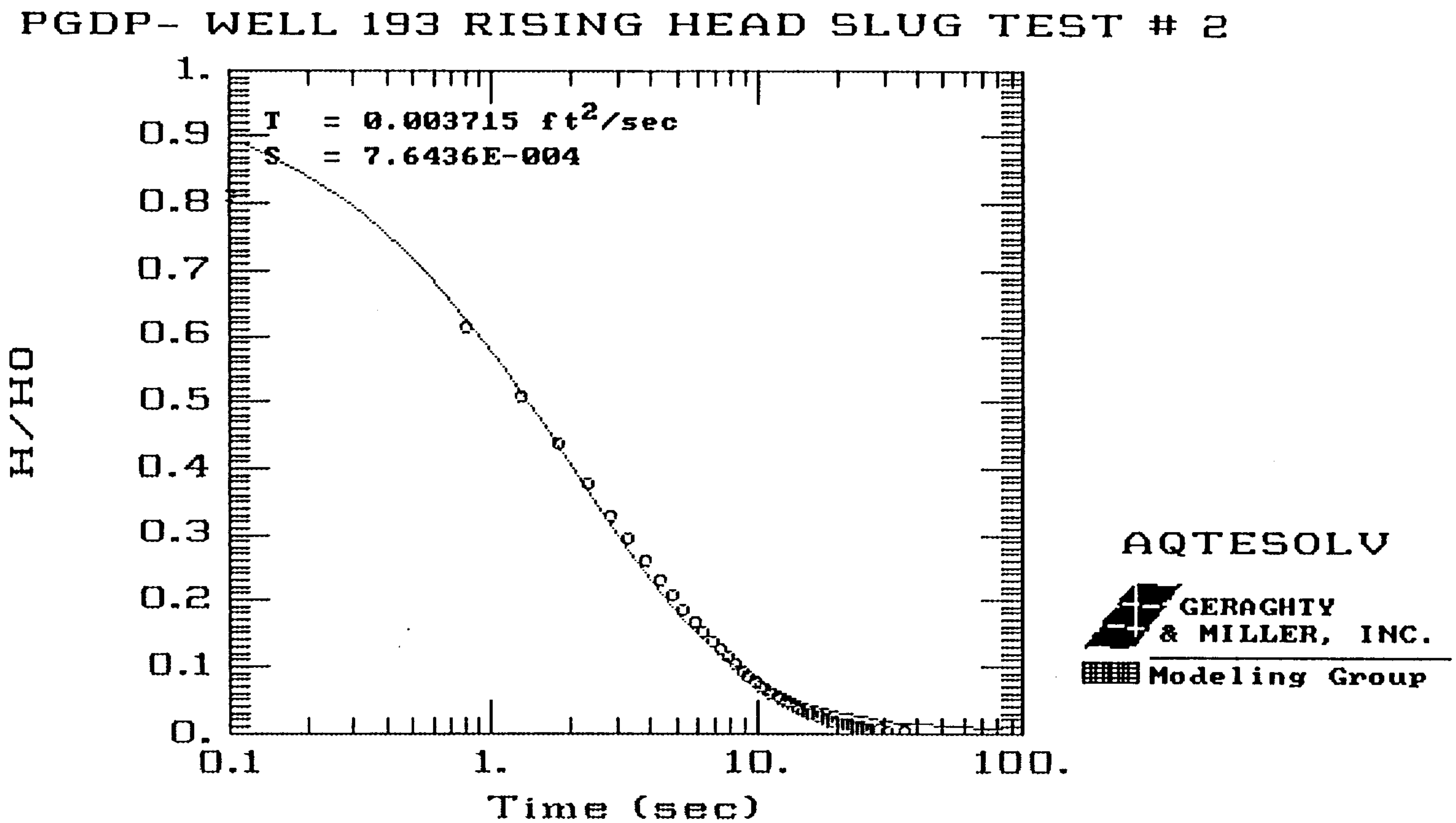

PGDP- WELL 193 RISING HEAD SLUG TEST # 2
T = 0.003715 ft²/sec
S = 7.6436E-004
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-14

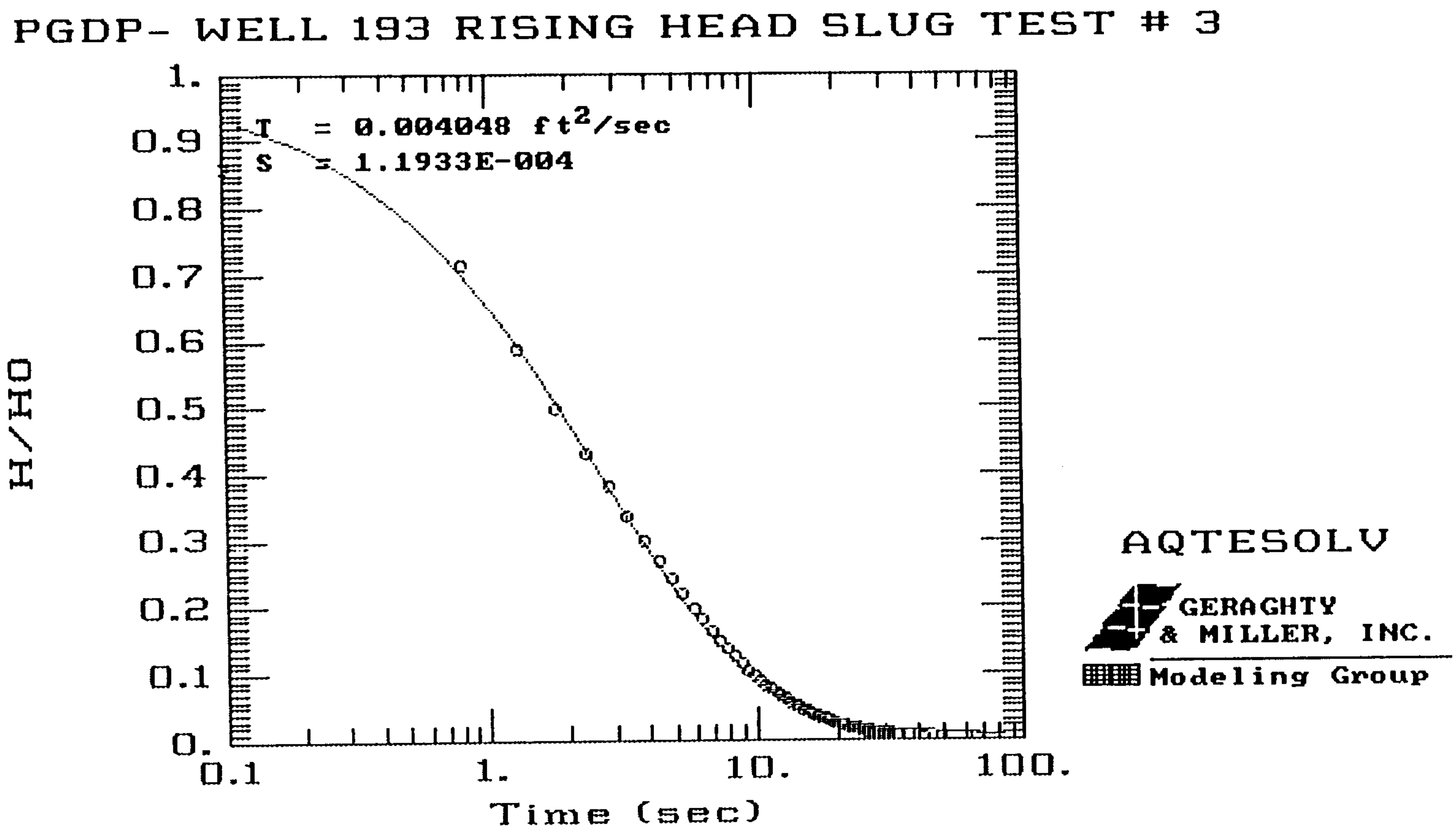
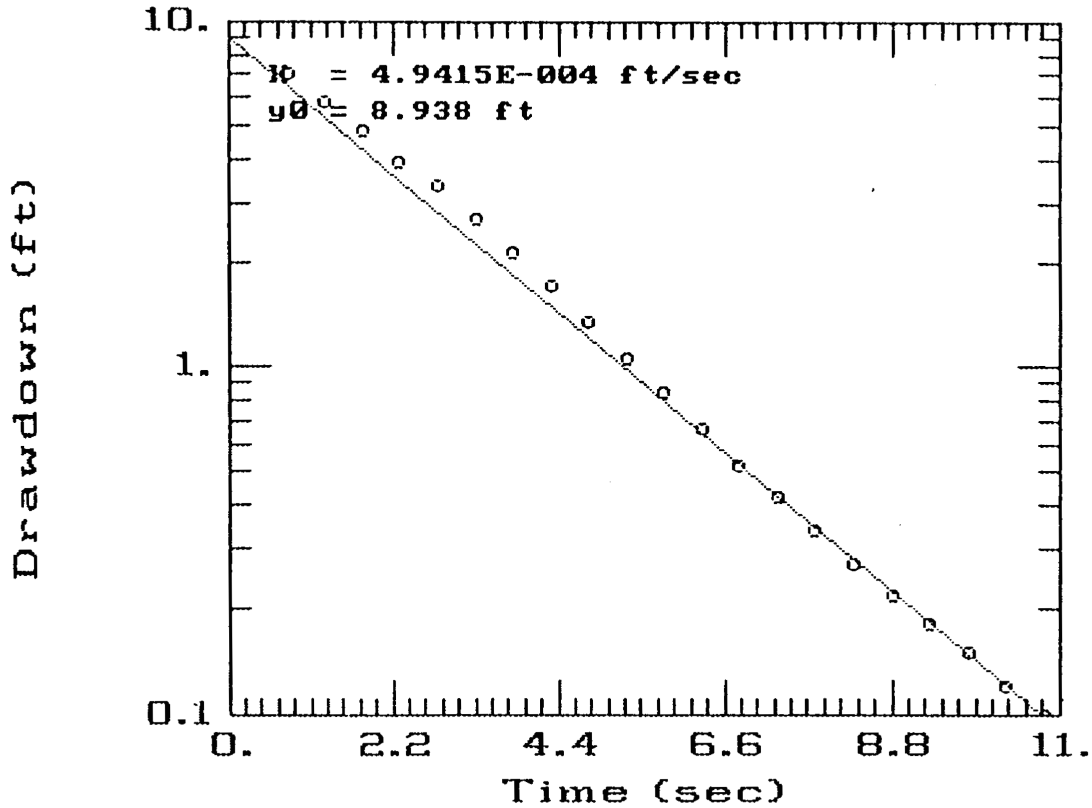

PGDP- WELL 193 RISING HEAD SLUG TEST # 3
T = 0.004048 ft²/sec
S = 1.1933E-004
H/HO
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-15

PGDP- WELL 194 RISING HEAD SLUG TEST # 1

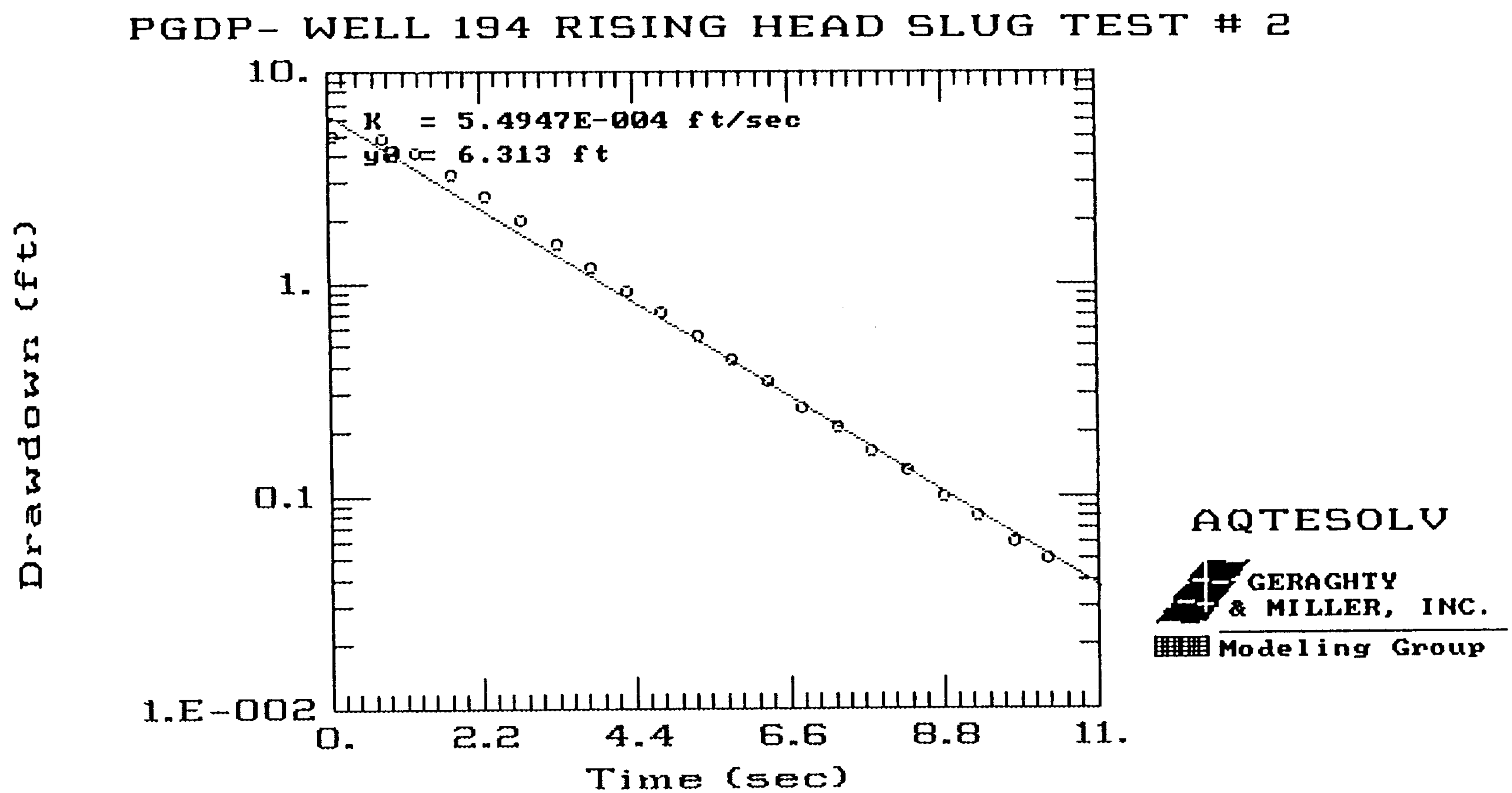


AQTESOLV

GERAGHTY & MILLER, INC.

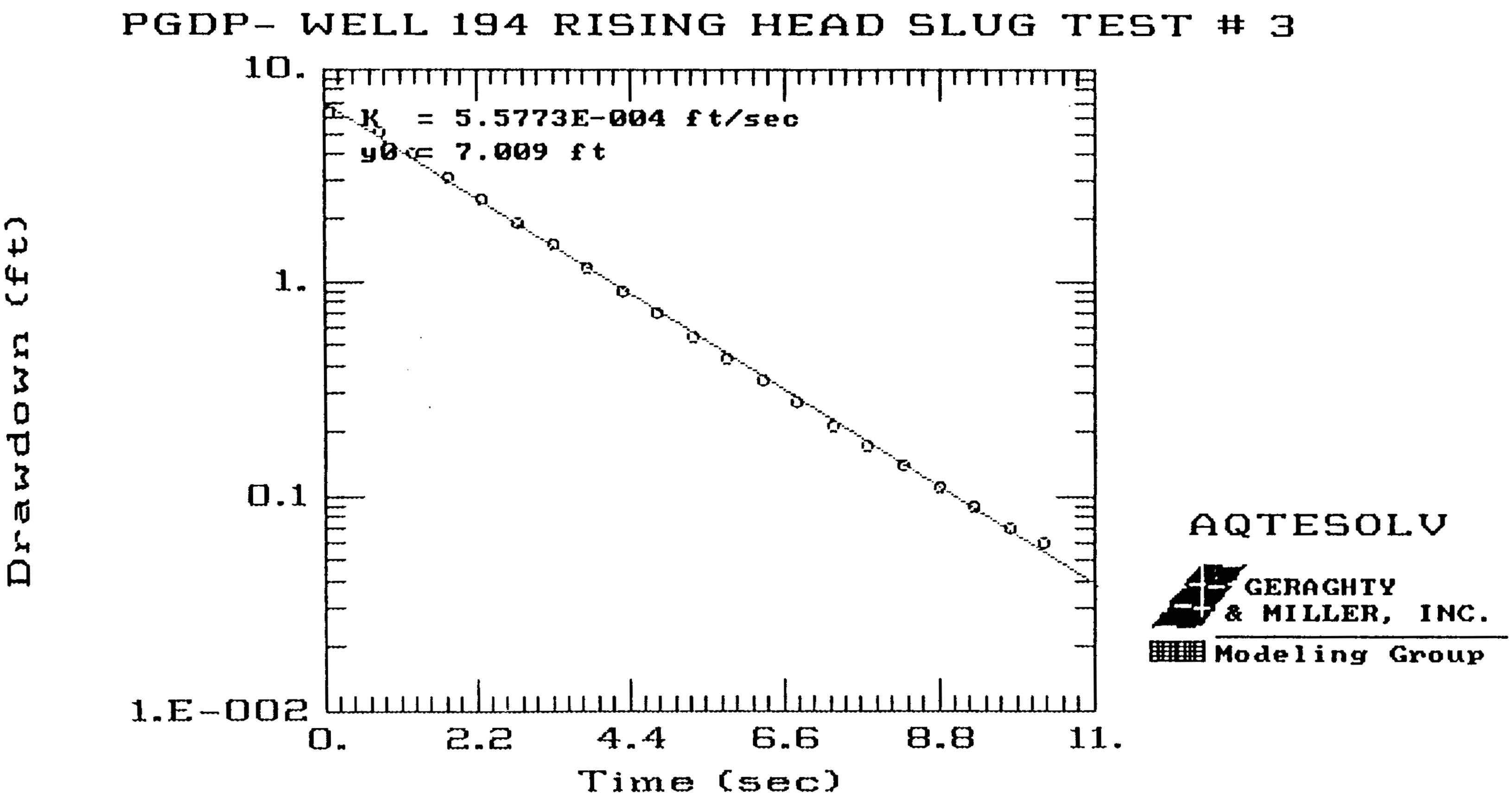
Modeling Group

Figure B-16

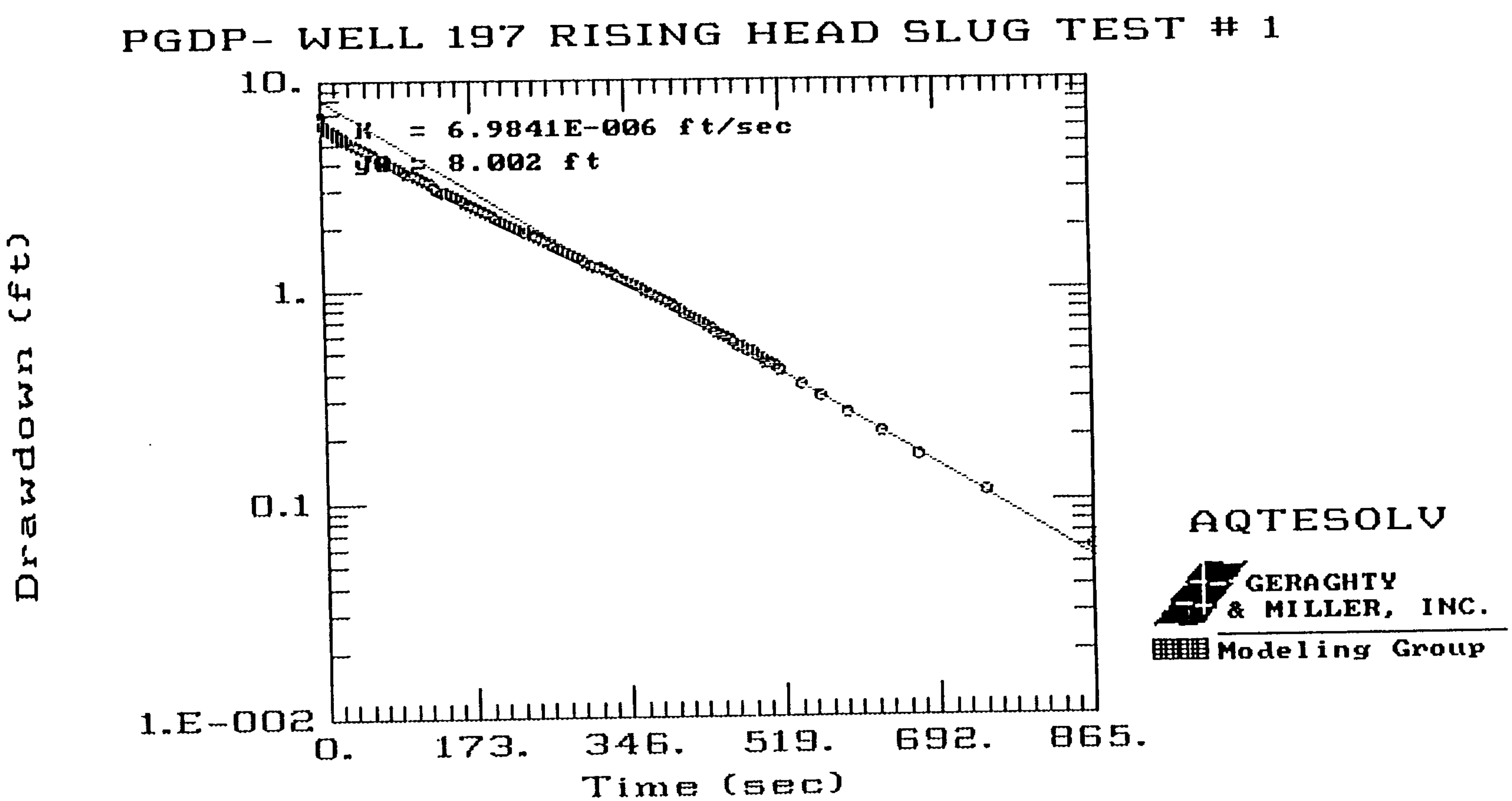


PGDP- WELL 194 RISING HEAD SLUG TEST # 2
K = 5.4947E-004 ft/sec
y0 = 6.313 ft
10.
1.
0.1
1.E-002
0.
2.2
4.4
6.6
8.8
11.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-17

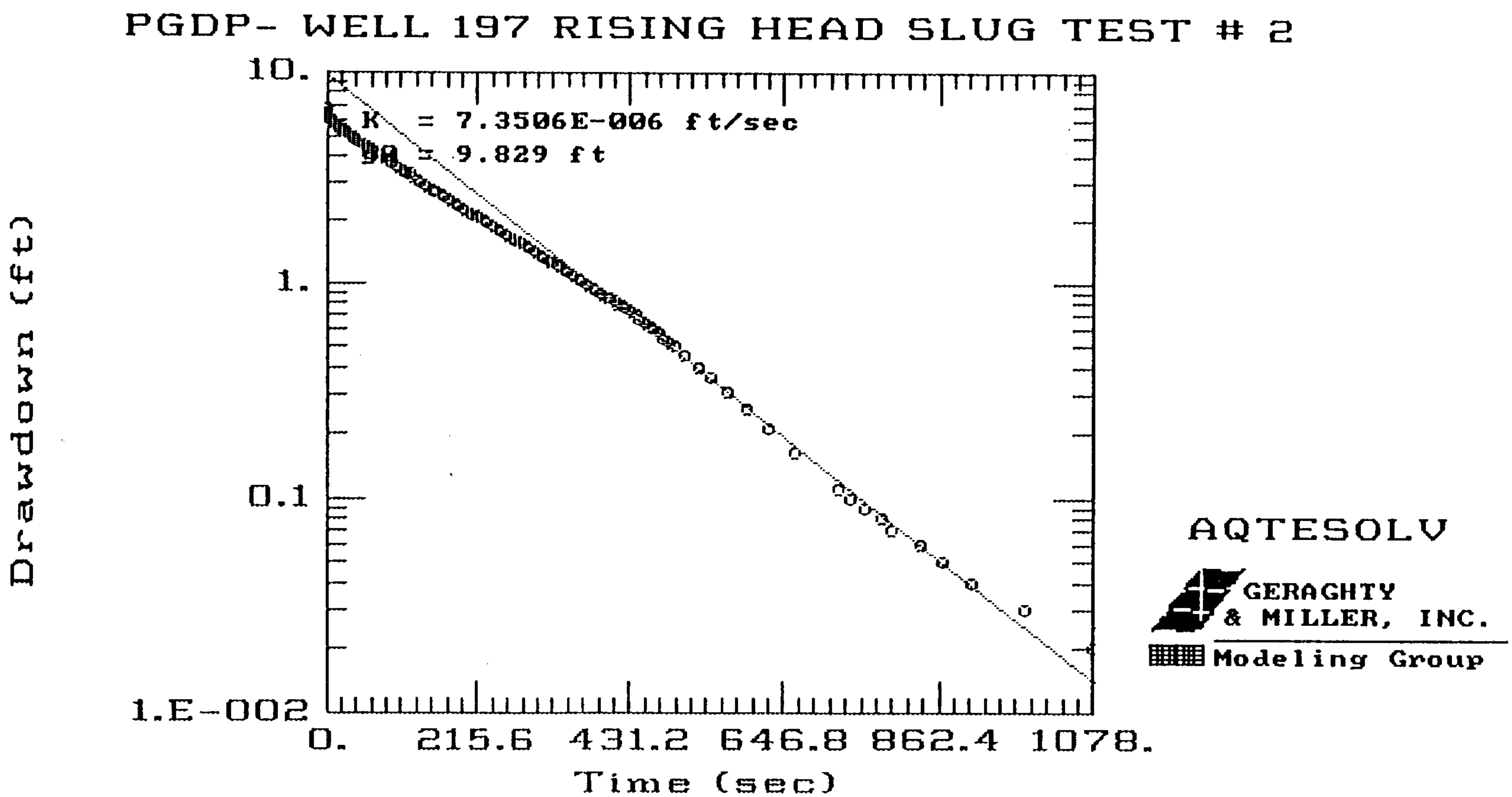

PGDP- WELL 194 RISING HEAD SLUG TEST # 3
K = 5.5773E-004 ft/sec
y0 = 7.009 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
2.2
4.4
6.6
8.8
11.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

. gure B-18



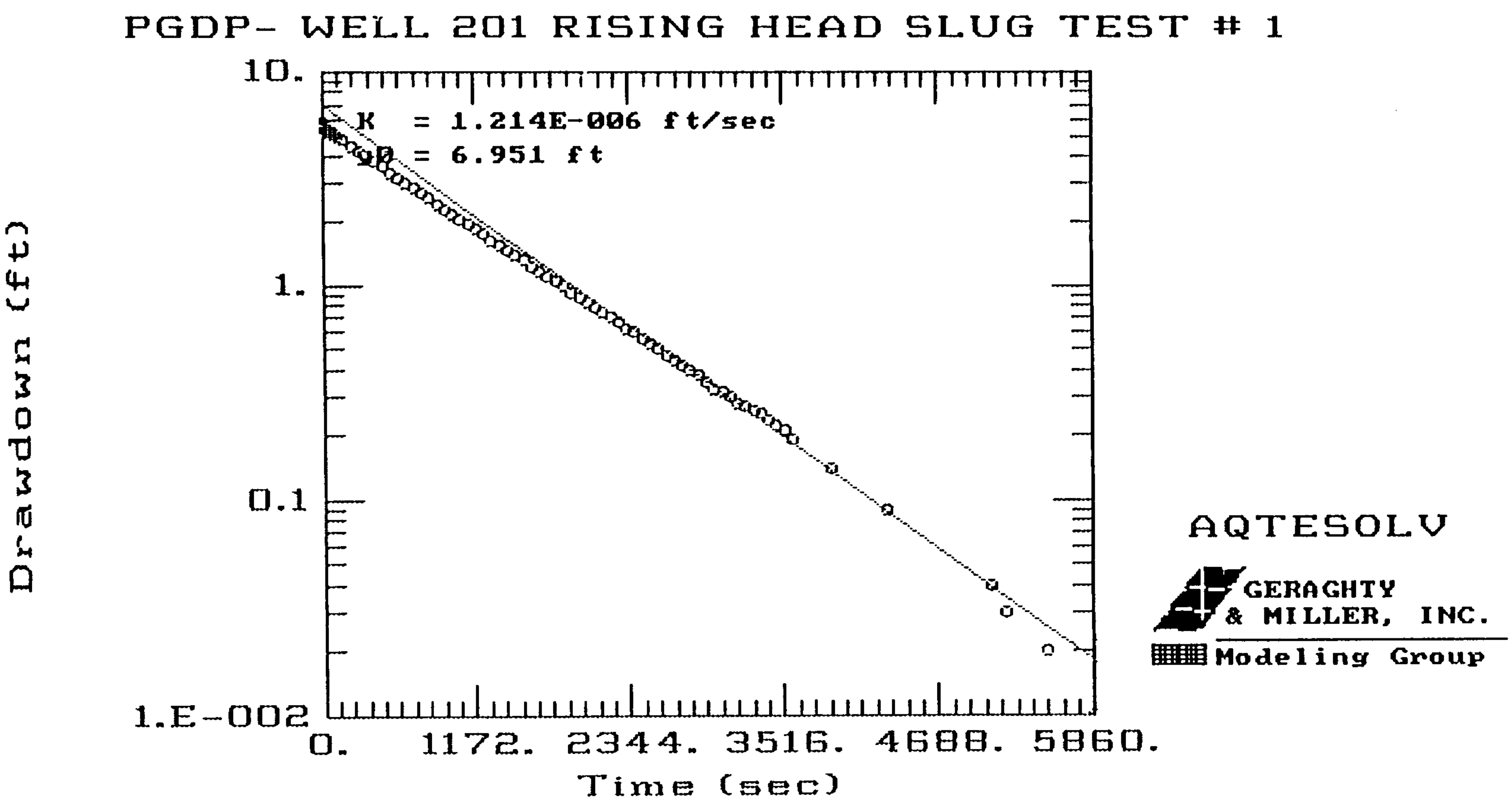
PGDP- WELL 197 RISING HEAD SLUG TEST # 1
K = 6.9841E-006 ft/sec
y0 = 8.002 ft
Drawdown (ft)
Time (sec)
10.
1.
0.1
1.E-002
0.
173.
346.
519.
692.
865.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-19



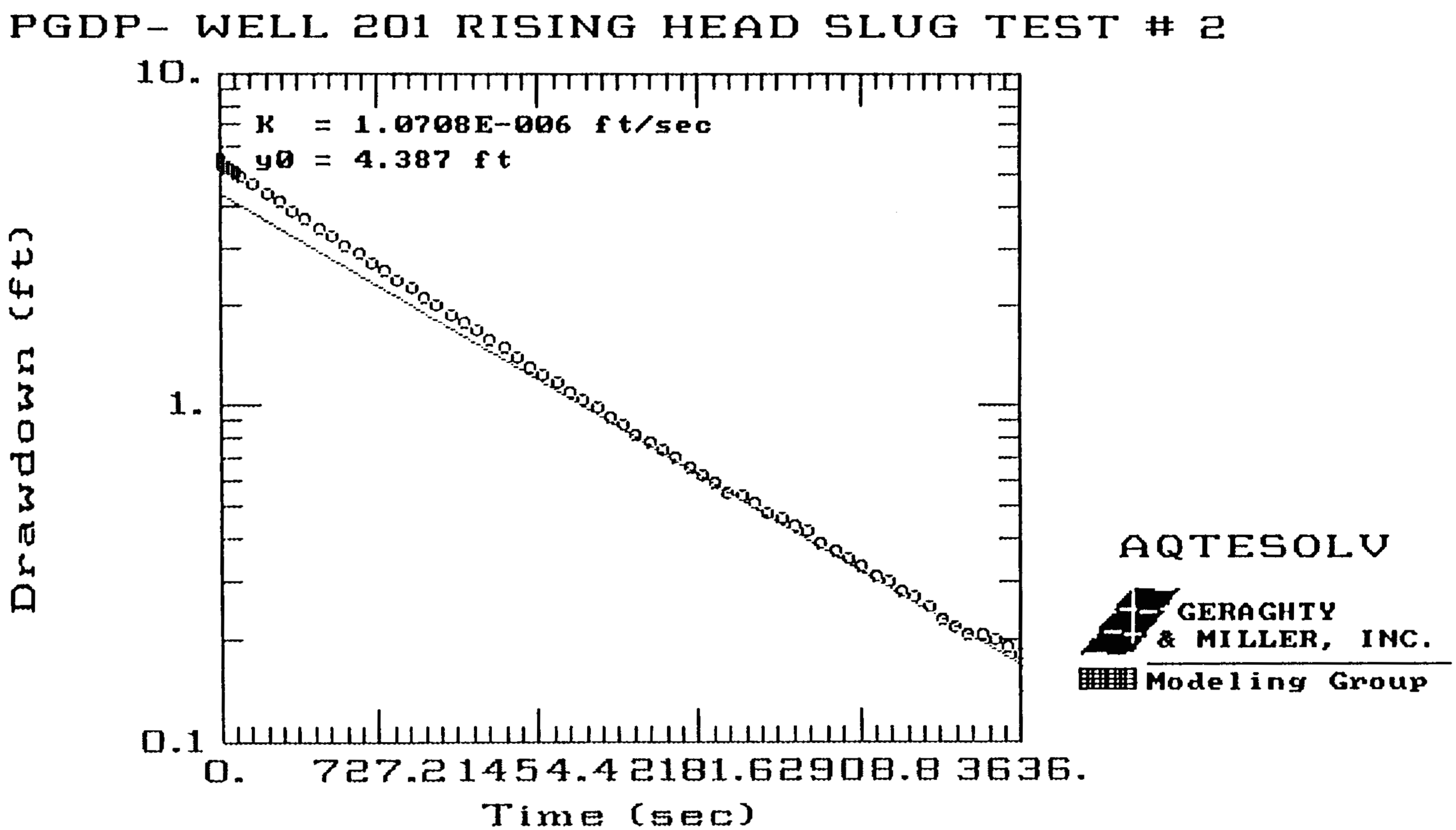
PGDP- WELL 197 RISING HEAD SLUG TEST # 2
K = 7.3506E-006 ft/sec
y0 = 9.829 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
215.6
431.2
646.8
862.4
1078.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-20



PGDP- WELL 201 RISING HEAD SLUG TEST # 1
K = 1.214E-006 ft/sec
y0 = 6.951 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
1172.
2344.
3516.
4688.
5860.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-21


PGDP- WELL 201 RISING HEAD SLUG TEST # 2
K = 1.0708E-006 ft/sec
y0 = 4.387 ft
10.
1.
0.1
Drawdown (ft)
0.
727.2
1454.4
2181.6
2908.8
3636.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

. igure B-22

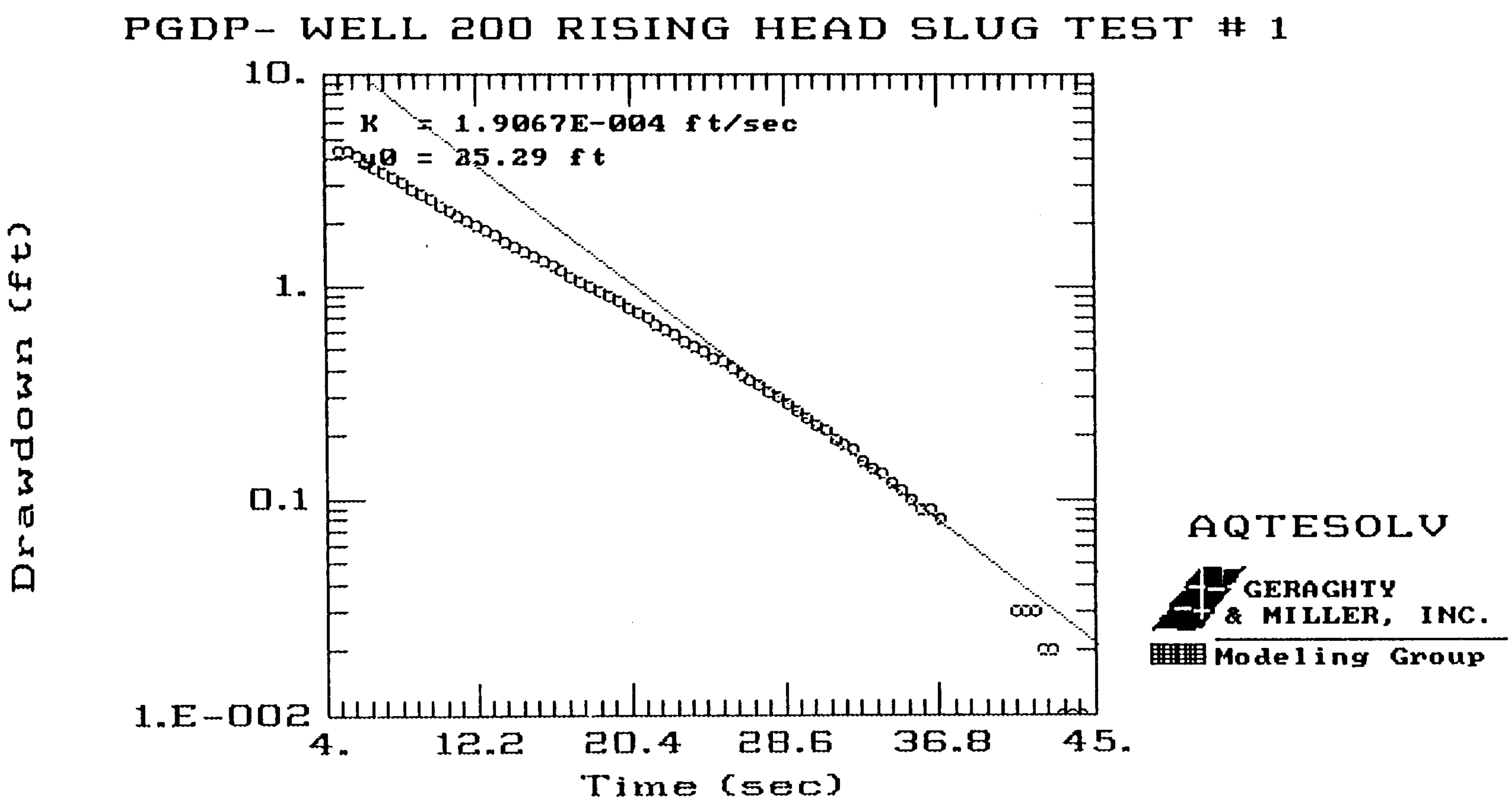
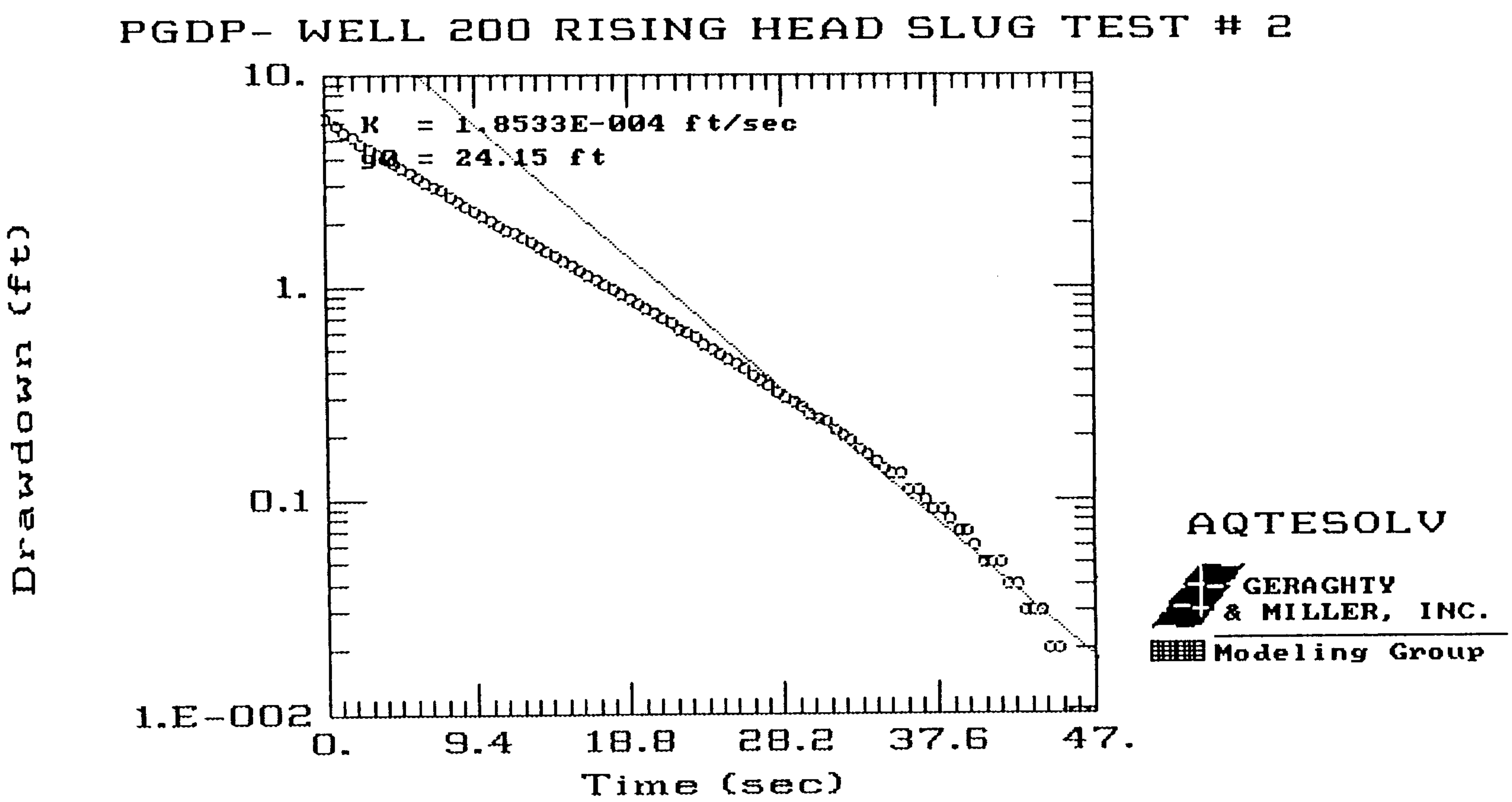

PGDP- WELL 200 RISING HEAD SLUG TEST # 1
K = 1.9067E-004 ft/sec
y0 = 25.29 ft
10.
1.
0.1
1.E-002
4.
12.2
20.4
28.6
36.8
45.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-23


PGDP- WELL 200 RISING HEAD SLUG TEST # 2
K = 1.8533E-004 ft/sec
y0 = 24.15 ft
10.
1.
0.1
1.E-002
Drawdown (ft)
0.
9.4
18.8
28.2
37.6
47.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

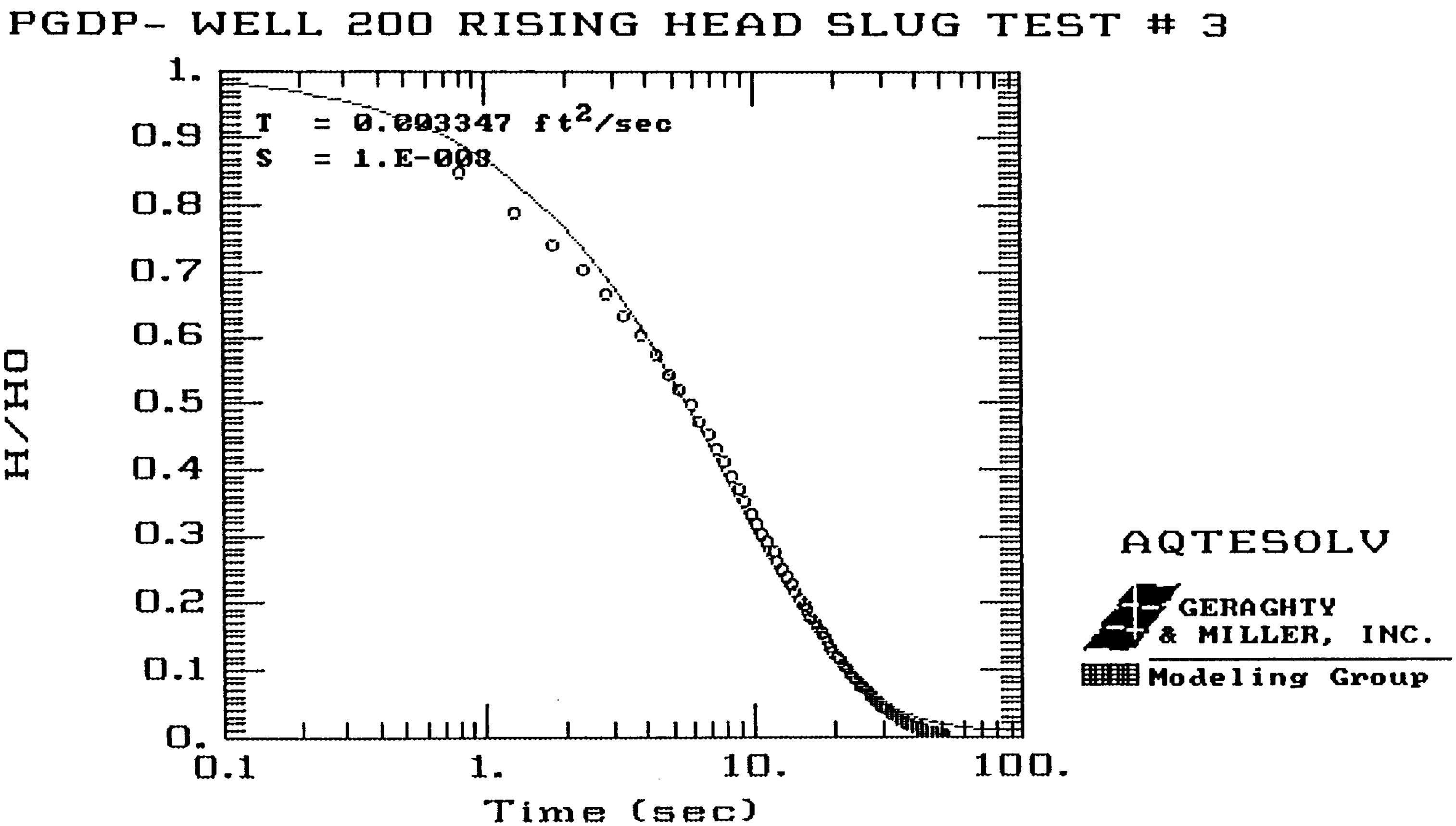
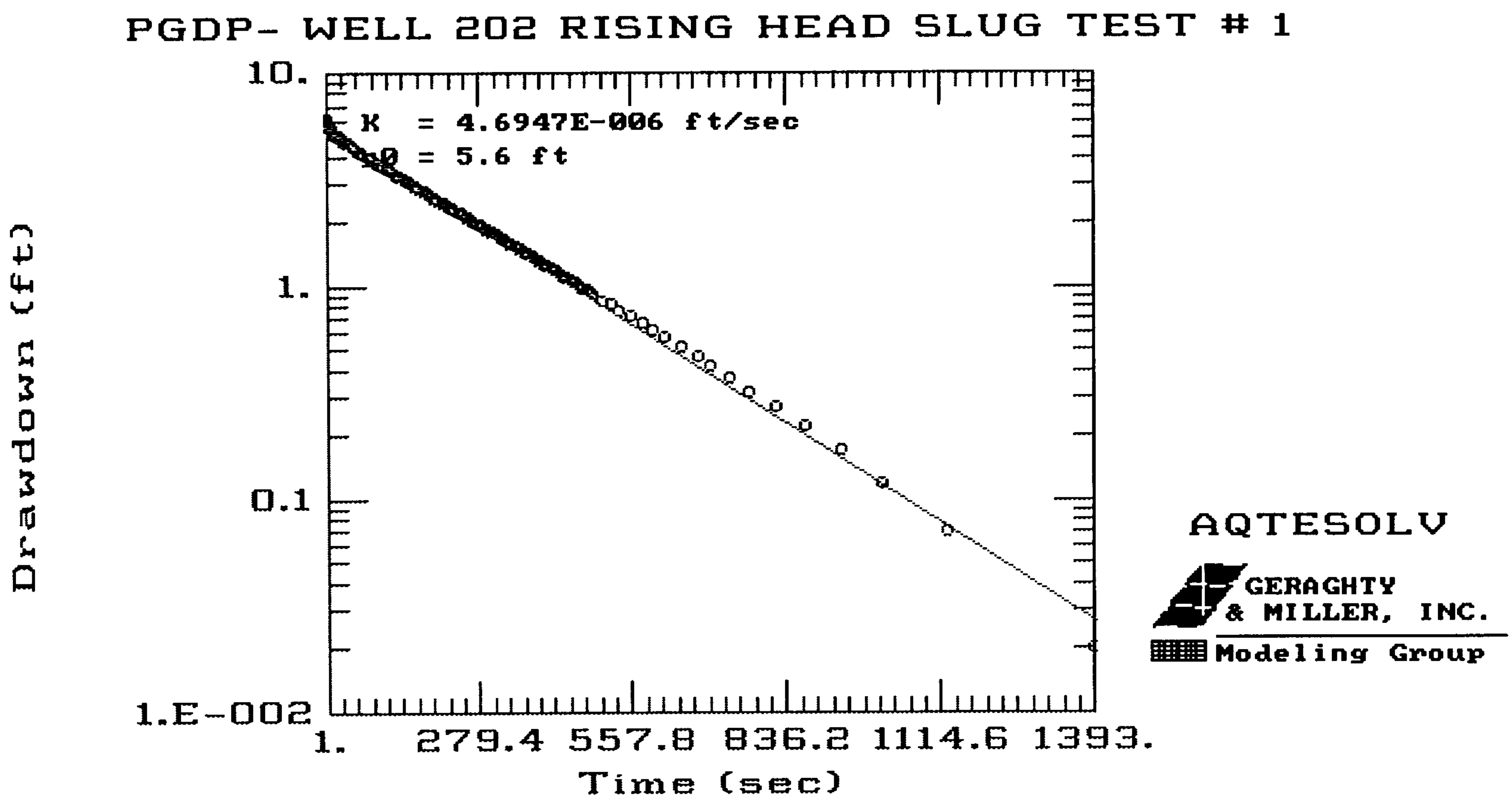

PGDP- WELL 200 RISING HEAD SLUG TEST # 3
T = 0.003347 ft2/sec
S = 1.E-008
H/HO
Time (sec)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
100.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-25



PGDP- WELL 202 RISING HEAD SLUG TEST # 1
K = 4.6947E-006 ft/sec
y0 = 5.6 ft
10.
1.
0.1
1.E-002
1.
279.4
557.8
836.2
1114.6
1393.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-25

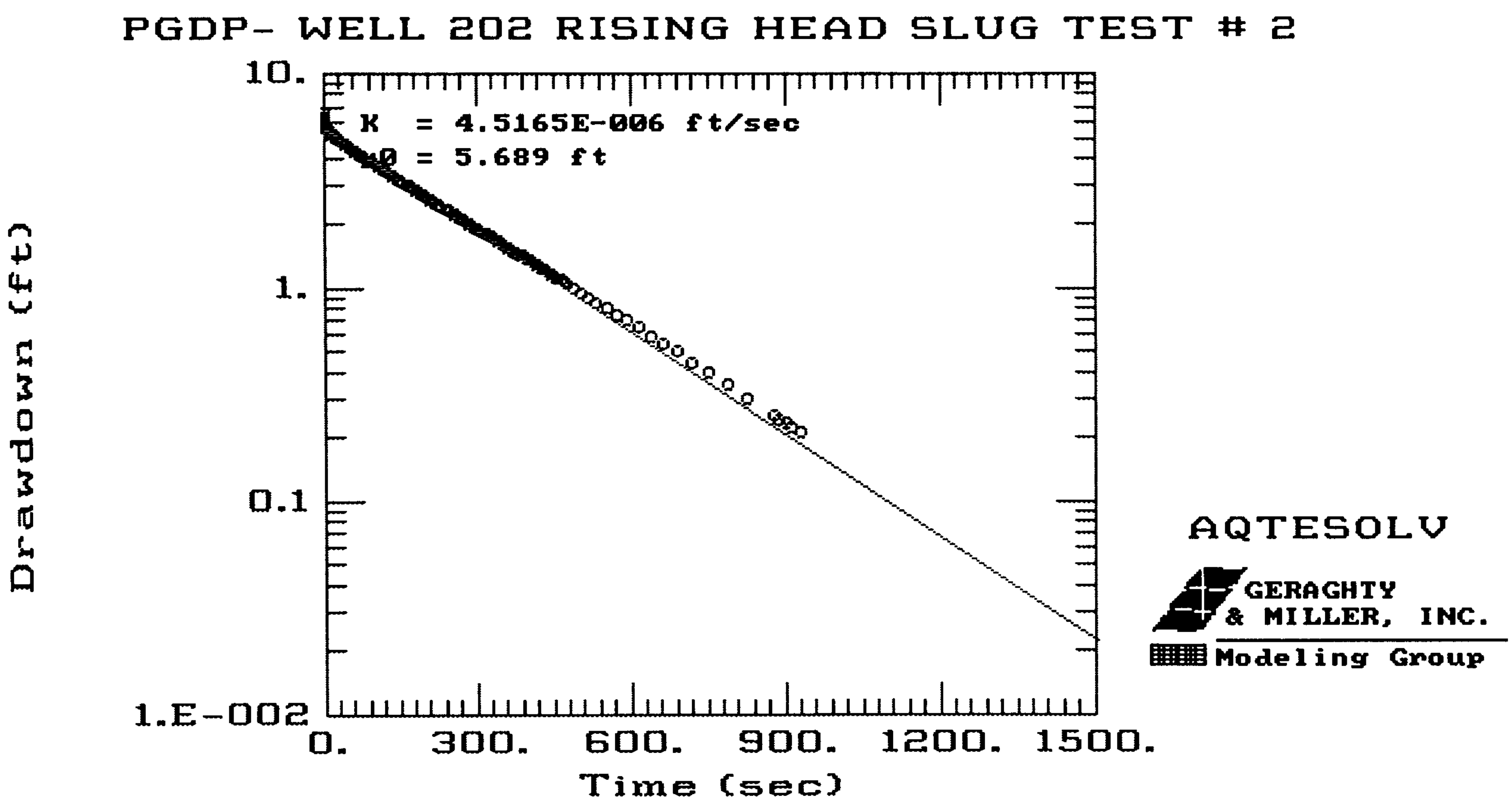
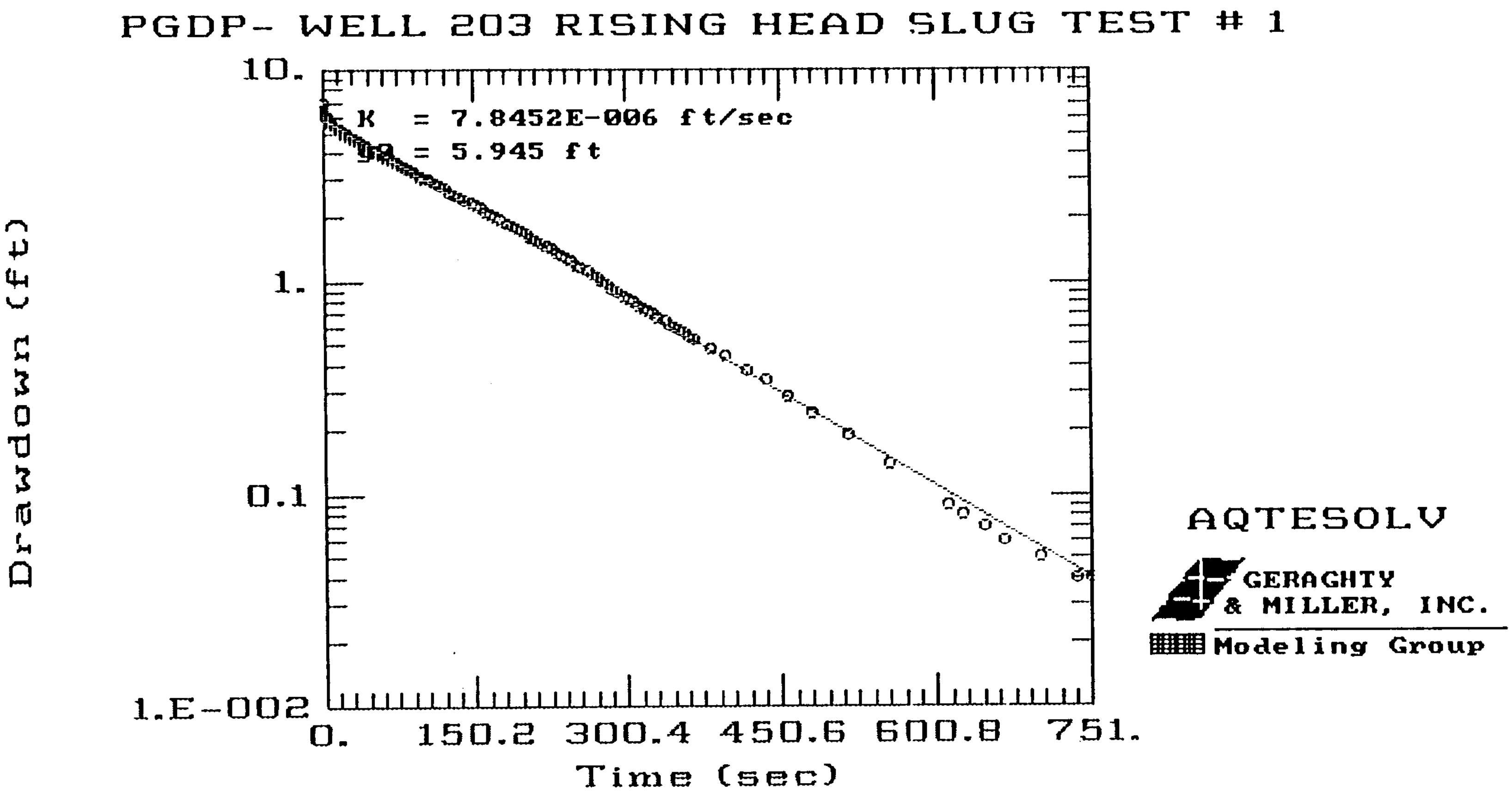
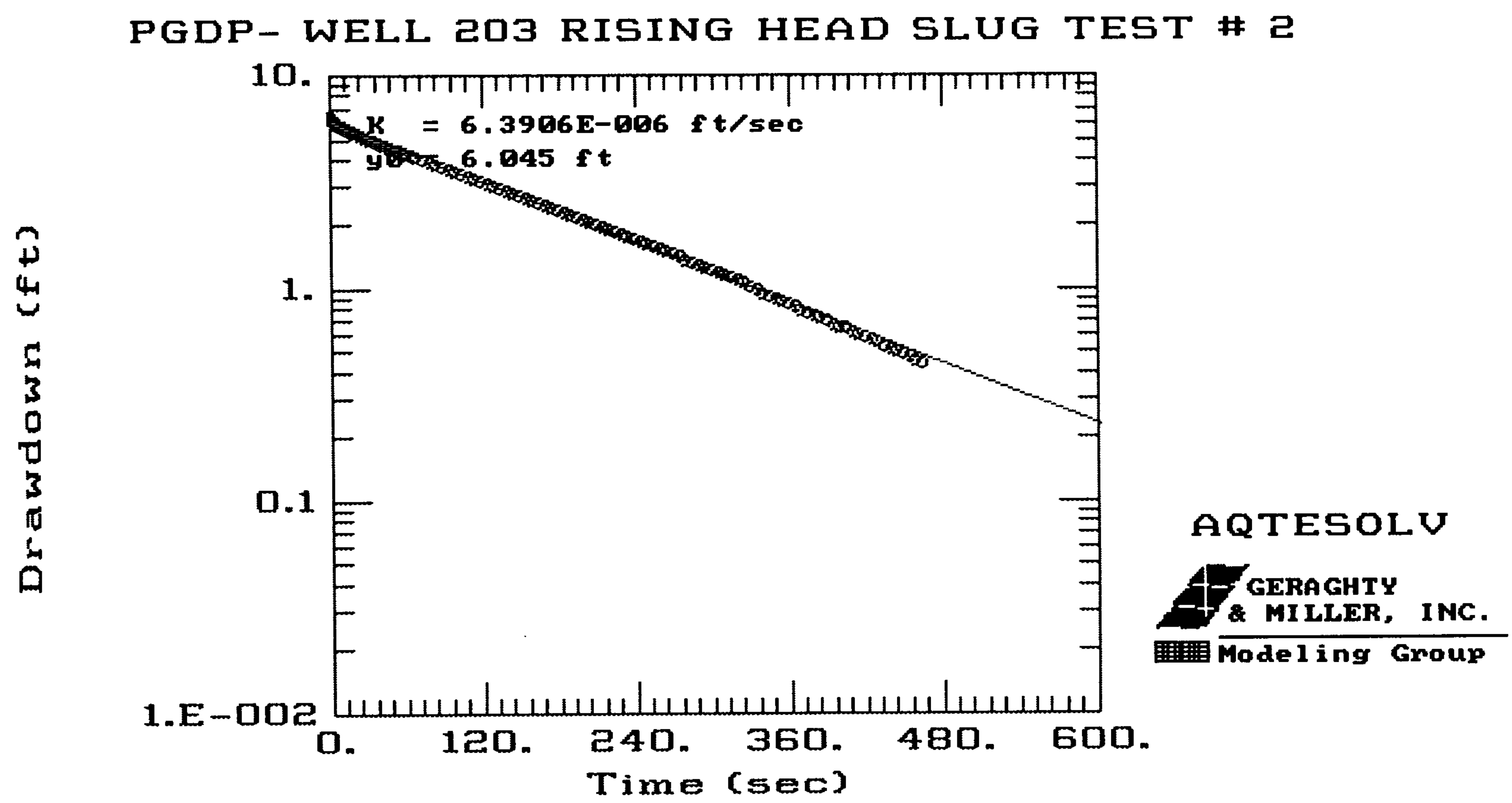

PGDP- WELL 202 RISING HEAD SLUG TEST # 2
K = 4.5165E-006 ft/sec
y0 = 5.689 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
300.
600.
900.
1200.
1500.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-27



PGDP- WELL 203 RISING HEAD SLUG TEST # 1
K = 7.8452E-006 ft/sec
y0 = 5.945 ft
Drawdown (ft)
10.
1.
0.1
1.E-002
0.
150.2
300.4
450.6
600.8
751.
Time (sec)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-28



PGDP- WELL 203 RISING HEAD SLUG TEST # 2
K = 6.3906E-006 ft/sec
y0 = 6.045 ft
10.
1.
0.1
1.E-002
0.
120.
240.
360.
480.
600.
Time (sec)
Drawdown (ft)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Figure B-29

APPENDIX 2B-7
Aquifer Pumping Test

TECHNICAL MEMORANDUM NO. 7
PGDP PHASE II SITE INVESTIGATION

PREPARED BY: Cliff Bell/NJO
Mary Kate Dwyer/NJO

SUBJECT: Aquifer Pumping Test

PROJECT NO.: NJO30888.BA

INTRODUCTION

PURPOSE AND SCOPE

A pumping test was performed as part of the Phase II Site Investigation to evaluate the local hydrogeologic characteristics of the Regional Gravel Aquifer (RGA) beneath the PGDP. Data obtained from the pumping test provided the necessary information to calculate coefficients of transmissivity and storativity, estimate aquifer anisotropy, and assess leakage from the shallow groundwater system to the RGA. This TM presents the results of the pumping test, including a description of the hydrogeologic units tested and the procedures used.

The pumping test location was north of the plant process buildings, in an area just west of the C-537 switchyard (WMU 85) (Figure 7-1).

One pumping well, five RGA piezometers, and three shallow groundwater system piezometers were installed for the pumping test. The shallow piezometers were positioned adjacent to RGA wells, forming couplets. The spacing and distances of the piezometers were selected, in part, to identify conditions of anisotropy.

The pumping test included a step-drawdown test, collection of background water levels, a 72-hour constant rate pumping test, and a 72-hour recovery test. Barometric pressure data were collected during the entire testing period. Water level data were collected and stored using Campbell Scientific and In-Situ Hermit dataloggers. Inorganic water quality parameters were monitored and groundwater samples were collected periodically throughout pumping.

The test focused on only a small area of the RGA. Given the apparent variability in lithology across the PGDP study area and the resulting distribution of conductivity, the test results may be applicable only in a limited area.

BACKGROUND

Hydrogeologic Setting

The unconsolidated sediments that underlie the PGDP are, in ascending order, the McNairy Formation, the Porters Creek Clay, the Continental Deposits, and surficial deposits of loess and alluvium.

The surficial deposits typically consist of silty clay or clayey silt and are referred to as the post-Continental Deposits. This unit may be characterized as a semiconfining layer because of a relatively low hydraulic conductivity.

The Continental Deposits underlying the surficial deposits consist of the Upper Continental Deposits and the Lower Continental Deposits. The Upper Continental Deposits are predominantly finer-grained clays and silts with interbedded sand lenses, and the Lower Continental Deposits are a gravel zone, which is a primary water-producing zone within the RGA.

Saturated sandy zones within the Upper Continental Deposits constitute the shallow groundwater system. Five shallow wells were monitored during the pumping test including three piezometers, which were installed for the pumping test. Seven deep wells were monitored during the test, five of which were installed for the pumping test. The pumping well fully penetrated the RGA. The monitoring wells only partially penetrated the RGA, with a 5-foot screen interval.

Previous Hydrogeological Studies

A 48 hour pumping test was conducted by Terran Corporation in September, 1989, at the C-404 area of the PGDP. The data were evaluated using several methods, including "leaky aquifer" formulae. These calculations yielded a transmissivity of 14,156 gpd/ft for the aquifer and a leakance factor of 0.174 gpd/ft^3 (TERRAN, 1990). It was determined that the lower sand and gravel aquifer was not totally confined and that the underlying and/or overlying aquitards were contributing recharge to the aquifer during the test.

Aquifer recovery slug testing was performed by CH2M HILL during both Phase I and Phase II. Estimates of hydraulic conductivity and transmissivity were calculated from the test data. Phase I test results indicated a range of hydraulic conductivity for the RGA from 2.2×10^{-4} cm/sec to 6.2×10^{-2} cm/sec. Estimated transmissivity ranged from 186 to 52,750 gpd/ft. Phase II test results indicated a range of hydraulic conductivity for the RGA from 3.4×10^{-5} cm/sec to 4.2×10^{-2} cm/sec. Estimated transmissivity ranged from 22 to 42,400 gpd/ft. This range of values is explained by aquifer heterogeneity and variable well construction.

TESTING METHODS

PUMPING WELL AND PIEZOMETER DESIGN

A total of three shallow and five deep piezometers and one pumping well were installed for the pumping test. The piezometers and pumping well were installed with truck mounted Central Mining Equipment drill rigs using 8-inch-O.D. soil augers. All piezometers were constructed of 2-inch diameter PVC riser pipe and 5 feet of PVC wire wound Johnson well screen with 0.01-inch openings. Each piezometer was also constructed with a sand pack to 5 feet above the screen, a bentonite seal approximately 5 feet thick above the sand pack, and grout in the annular space above the bentonite seal. The grout was installed with a tremie pipe. The grout composition is approximately 186 pounds of portland type 1 cement (2 bags), 6 to 8 pounds of bentonite, and 14 gallons of water.

The shallow groundwater system piezometers were installed by drilling an 8-inch-O.D. auger hole to bottom depth. The RGA piezometers were constructed by first augering a 10-inch hole and installing an 8-inch-I.D. steel isolation casing through the shallow groundwater system. Drilling was performed through the RGA using 8-inch-O.D. soil augers. The RGA piezometers were not fully penetrating.

Each of the piezometers was developed for approximately 4 to 6 hours until the final development water was clear to slightly cloudy.

The pumping well was constructed with 6-inch diameter carbon steel riser pipe and 40 feet of wire wound screen with 0.01-inch openings. The shallow groundwater system was isolated with 40 feet of 12.5-inch diameter steel casing grouted in place. The well was fully penetrating and developed for approximately 24 hours.

The first attempt at drilling the pumping well was unsuccessful and the well was left abandoned about 10 feet from where the pumping well stands. This abandoned well, referred to as PW-1 Defunct, consists of an 8-inch casing keyed into the confining layer underneath the RGA. The casing broke at approximately 2 feet below grade and a temporary riser-pipe was later installed to grade.

Construction details of the piezometers and the pumping well along with soil boring logs are included in Attachment A.

PUMPING TEST SETUP

Eight piezometers were installed around the pumping well at range of 14 to 61 feet. Five of the piezometers were screened in the RGA and three were screened in the shallow groundwater system. The piezometers were spaced at different directions, radiating from the pumping well (Figure 7-2). This design was intended to allow for resolution of maximum and minimum directions of hydraulic conductivity as per Papodopolous (1965) and Hantush and Thomas (1966). The shallow piezometers were useful in evaluating leakance from the shallow groundwater system to the RGA. Placement of three piezometers along one ray was designed to allow for distance drawdown analysis.

Pumping System

The pump used for the test was a Goulds 150L submersible pump capable of delivering 150 gpm against 700 feet of head. The pump was sized based on values of specific capacity and flow rate during development of the pumping well and consideration of the head loss across the entire testing system.

The total depth of the pumping well (PW1) was 100 feet. The pump was lowered down the well so that the water intake was at a depth of 94.5 feet. The static water level was at 49 feet below grade. Approximately 45.5 feet of water was available in the well for drawdown before the top of the pump was exposed to air. Three-inch-diameter black steel pipe was used as a discharge line within the well. Three-inch flexible hosing was used to connect the black steel discharge line to 3-inch-PVC piping at ground level. A sampling tee was installed at the wellhead for the collection of groundwater samples.

The 3-inch-PVC pipe was reduced to 3 feet of 2-inch-PVC straight pipe leading into a Great Lakes impeller-style flow meter. The flow meter was electronically integrated with the Campbell Datalogger, which kept instantaneous and accumulative flowrates. At least 3 feet of 2-inch- PVC led from the Great Lakes flowmeter to another PVC straight-pipe of the same diameter. This pipe led to a turbine style flowmeter installed to check the performance of the Great Lakes flowmeter. At least 3 feet of 2-inch-PVC pipe led from the turbine-style flowmeter before expanding back to 3-inch-PVC pipe, which led to a 3-inch globe valve. The 3-inch pipe leading from the globe valve expanded to 4-inch pipe which led to the north-south diversion ditch. A portable gasoline-fueled generator was used to power the pump, lights, and other electrical devices used to conduct the pumping test.

Monitoring System

Monitoring of background, drawdown, and recovery data was performed by several Campbell Scientific 21X dataloggers and a Hermit 1,000C datalogger. Both datalogger types were integrated with Druck pressure transducers of varying pressure ranges. The software program, "WATLEV7.DLD," developed by CH2M HILL and used routinely for long-term monitoring of water levels, was downloaded into the dataloggers. A portable microcomputer was used to communicate with each datalogger.

Eight piezometers were installed for the pumping test, and four existing monitoring wells in addition to the pumping well and an abandoned pumping well hole were monitored with dataloggers during the pumping and recovery tests. The shallow groundwater system monitoring network included PZ-3S, PZ-4S, PZ-5S, MW-164, and MW-166. The RGA monitoring network included PZ-1G, PZ-2G, PZ-3G, PZ-4G, PZ-5G, MW-163, MW-165, the pumping well (PW1), and PW1 (Defunct). Water levels in monitoring wells MW-173, MW-174, MW-177, MW-178, MW-181, and MW-182 were measured on a daily basis during the pumping test.

Each transducer was installed at a depth below the water level roughly equivalent to its rated psi. In this way, the full measurement range of the transducer was used. Transducers were secured to the standpipes.

The transducers were connected to the dataloggers, which were enclosed in rain-proof cases. All dataloggers were located within the perimeter of the pumping test zone. Transducer extensions were used to monitor MW-165 and MW-166, approximately 150 feet from the pumping well. An In-Situ datalogger was located at MW-163 and MW-164 and monitored water levels at this location. All dataloggers were programmed with the same time and Julian day, so that recordings made at all locations could accurately be compared.

Transducer Tests

Changes in monitoring well and piezometer water levels were recorded using Campbell Scientific and In-Situ dataloggers connected to Druck pressure transducers. Transducers used for the pumping test were rated at 5, 10, 20, and 50 psi. The 5-psi transducers were installed in the more distant piezometers and the shallow groundwater system piezometers. The 10- and 20-psi transducers were used on the RGA piezometers closer to the pumping well. The 50-psi transducer was installed in the pumping well.

Several transducers were tested for measurement drift and accuracy. This testing was performed indoors under controlled conditions prior to mobilizing to the field. Drift testing was performed on eight transducers by submerging them in a bucket of standing water and collecting measurements for an 8-hour period. Transducer drift ranged from .01 to 0.05 foot over a half-hour period. Fluctuations over 0.02 foot are attributed to external influences since the fluctuations were not random but synchronized over all of the transducers.

The accuracy of eight transducers was tested under controlled conditions indoors. Accuracy testing was performed by subjecting the transducer to pressures ranging from 1 psi to its rated pressure while checking instrument response. All transducers responded to within 2 percent of the test pressures.

BACKGROUND WATER LEVELS AND BAROMETRIC PRESSURES

Background water levels were recorded for periods ranging from 2 days to 15 days prior to the pumping test in all wells that were monitored during the pumping test. Only 2 days of data were available for piezometers PZ-4S and PZ-5S because transducers were inadvertently removed and not replaced. Depth to water measurements were also taken on select days from wells MW-177, MW-178, MW-173, MW-174, MW-181, and MW-182.

A barometer was connected to the datalogger at one of the background well locations at the beginning of the 2-week monitoring period. However, when the well pads were being completed, the barometer was taken down from its position and was not put back properly. Barometric pressures obtained from this instrument therefore could not be used. Barometric readings were obtained from the Paducah Weather Station for the duration of the background monitoring period and the pumping and recovery test period.

STEP-DRAWDOWN TEST

A step-drawdown test was conducted on the pumping well on June 9, 1991, before the constant rate pump test. The step-drawdown test was planned by first recording a flowrate of 180 gpm at a drawdown of about 33 feet of the available head of 50 feet. This was considered the last step, as drawdown conditions over 2/3 available head are very unstable. Since reducing the pumping rate under 60 gpm resulted in pressure conditions over 100 psi, which is beyond the tolerance of the Great Lakes flowmeter, a range of 120 gpm remained for partitioning steps for the step-drawdown test.

Four pumping steps were performed at 64 gpm, 108 gpm, 147 gpm, and 178 gpm. During the fourth step, the pump rate had to be reduced to 152 gpm after 10 minutes of pumping because of the decreased specific capacity after 3 hours of pumping.

CONSTANT RATE PUMPING TEST

The 72-hour constant rate pumping test was performed from June 12 to 15, 1991. CH2M HILL, Eberline, and Brotcke personnel provided continuous coverage of the test. Before the test was started, water levels were measured in each of the monitoring wells to be monitored during the test. The dataloggers were programmed to record water levels at 5-second intervals just prior to the start of the test. The test began at 9:50 a.m. on June 12, 1991, and the well was pumped at 92 gpm. The plot of step-drawdown data suggested that pumping the well for 72 hours at the second step (108 gpm) would consume slightly less than the total available head. The lower pump rate was used to ensure that the aquifer would not be dewatered and the test could be conducted over the entire 72-hour period.

The dataloggers were switched to 1-minute recording intervals shortly after the test startup and to 15-minute intervals after drawdown levels had stabilized. These recording intervals were changed only after the difference between successive measurements was less than 5 percent of the total drawdown up to that time.

Data were periodically downloaded from the dataloggers throughout the duration of the test. The data were reduced and plotted to monitor the shape of the drawdown curves and the progress of the test. Hardcopy drawdown plots were generated in near real time from a printer installed in the field van. These plots were made available to Martin Marietta personnel and CH2M HILL team management and technical personnel. Flow rate was closely monitored on both flow meters throughout the test to ensure that the flow rate was kept at a constant rate of 92 gpm.

The total volume of water discharged during well development was 14,000 gallons, whereas the step-drawdown test discharged 34,260 gallons. The constant rate test discharged 397,440 gallons.

RECOVERY TEST

The pumping well and all wells and piezometers were monitored during the recovery period from June 15 to June 18, 1991. Before the pump in PW-1 was shut off, datalogger recording intervals were changed to 5 seconds. The pumping was stopped at 9:50 a.m. on June 15. The datalogger was switched to 1-minute recording intervals shortly after the test ended and to 15-minute intervals after recovery levels had stabilized. These recording intervals were changed only after the difference between successive measurements was less than 5 percent of the total recovery up to that time.

Drawdown data from the start of the pumping test to the cessation of pumping were downloaded immediately after the pump was shut down. Recovery data were collected from the cessation of pumping until 9:55 a.m. on June 18, 1991.

GROUNDWATER SAMPLING

Groundwater samples were collected from the pumping well to determine whether groundwater quality was in compliance with the discharge permit. Samples were collected after the pump was installed, during the step-drawdown test, and during the constant rate step-test. Samples were collected from the sampling tee installed at the pump head. Sample bottles were provided by PGDP. Approximately 1 gallon of water was purged from the flow line through the sample port before the samples were collected.

After the samples were collected, the bottles were labelled to indicate the date, time, location of sample, and sampler's initials. Samples were sealed in a ziploc bag and placed on ice in a cooler until delivery to the PGDP laboratory. A chain-of-custody form was completed for the samples in each cooler that was delivered to the laboratory. Samples were analyzed for TCE, uranium, Tc-99, fluoride, aluminum, chromium, copper, iron, nickel, zinc, nitrate, sulfate, chloride, M. alkaline, P. alkaline, silicon, manganese, potassium, calcium, magnesium, and sodium.

ANALYSIS AND RESULTS

BACKGROUND WATER LEVELS AND BAROMETRIC PRESSURE

Changes in barometric conditions commonly cause water level variations in wells and piezometers screened in confined aquifers (Todd, 1980). The relationship is inverse: increases in barometric pressure cause a decrease in the water levels. Changes in background water levels were plotted against changes in barometric pressure for each of the piezometers and wells tested at the PGDP. The water level changes are expressed as deviations from the mean water level for the measurement period. The barometric data are an expression of the changes in barometric pressure over the testing period relative to the first barometric reading. These changes are also expressed as deviations from the mean. This allows for comparison of both series on the same graph. Both series are expressed as equivalent feet of water head. The barometric pressure over the entire testing period is presented in Attachment B. The pumping test and recovery periods are designated in this plot. The water-level-barometric plots are also presented in Attachment B.

Barometric efficiency is expressed as:

$$B = h/\Delta p$$

where

h = piezometric change (ft of water)
p = barometric change (ft of water)

Although actual calculations of barometric efficiencies from the plots were not performed, it appears that the water levels in the gravel aquifer wells are almost totally dependent on barometric changes. In the shallow wells, however, water level response to fluctuations in barometric pressure is not nearly as evident, if discernable at all. Barometric efficiencies were calculated for each of the plots by measuring the approximate amplitudes of related peaks of each series, then dividing the barometric amplitude into the water level amplitude. Peaks representative of the relationship across the entire measurement period were chosen in each well. These values are presented in Table 7-1.

Table 7-1
Barometric Efficiencies
PGDP Phase II Site Investigation

Well	Aquifer	Approximate Value in Percent
PZ-1G	RGA	>100
PZ-2G	RGA	100
PZ-3G	RGA	100
PZ-4G	RGA	82
PZ-5G	RGA	100
PZ-3S	SGS	Not Discernable
PZ-4S	SGS	Not Discernable
PZ-5S	SGS	Not Discernable
MW-163	RGA	100
MW-164	SGS	100
MW-165	RGA	100
MW-166	SGS	50

OROR2/012.51

Because of the difficulty of measuring precise amplitudes, any pair of peaks that approximated 100 percent were assigned as such. Each of the RGA wells and piezometers is approximately 100 percent efficient except PZ-4G. The relationship in MW-164 is roughly equivalent to 100 percent but the overall pattern is vastly different from that of the gravel aquifer wells. Some other external influence such as infiltration has probably increased the range of the water-level series during the measurement period for this well. This has the effect of reducing the resolution on the barometric plot because the ordinate axis is expanded. This phenomenon occurs in each of the shallow groundwater system wells.

Table 7-2 presents manual water level measurements taken from wells MW-173, MW-174, MW-177, MW-178, MW-181 and MW-182.

STEP-DRAWDOWN DATA

Time-drawdown data from the step-drawdown test were plotted as one complete series from the start of the step-drawdown test to the completion of the final step. This curve is presented in Figure C-1 of Attachment C. The irregular "bump" on the fourth step was the result of having to have to decrease the flow rate from 178 gpm to 156 gpm several minutes after advancing to the fourth step. This was necessary because the pumping level dropped precipitously just after advancing to the fourth step. It became apparent that the pumping level may have eventually fallen below the pump intake, and the flow-rate was consequently reduced.

Table 7-3 presents the flow rates and drawdown values after 60 minutes of pumping for each of steps 1-4. Also presented in this table are the coefficients s/Q. These values are necessary for the graphical approach (Bierschenk [1964]) to Jacob's (1946) solution for examining the performance of wells having turbulent flow:

$$s = BQ + CQ^2$$

where

s = drawdown in a well (in feet)
BQ = head loss due to laminar conditions in both aquifer and well
CQ^2 = head loss due to turbulent conditions in both aquifer and well.

Table 7-2
Water Levels in Remote Monitoring Wells
PGDP Pumping Test Data
PGDP Phase II Site Investigation

	Background Period					Pumping Test Period		
	5/23	**5/24**	**5/28**	**5/29**	**5/30**	**6/12**	**6/13**	**6/14**
MW-173						41.25	41.34	41.34
MW-174		7.00	6.78	6.63	6.61	7.20	7.31	7.31
MW-177	45.31	45.24	45.41	45.14	44.90	46.42		46.54
MW-178	46.65	46.63	46.71	46.50	46.44	44.88		45.02
MW-181	39.68	39.64	39.73	39.60	39.31	39.53	39.62	39.61
MW-182	12.45	12.94	12.32	12.26	12.13	13.46	13.56	13.62

Note: All depth to water measurements referenced from top of steel casing.
MW-181 and MW-182 referenced from top of well wizard pump.
All measurements recorded in feet.

DEN/181R/050.51

Flow (Q) (gpm)	s (ft)	s/Q
64	8	.125
106	17	.160
147	27	.184
156	35	.224

Table 7-3
Step-Drawdown Flow Rates and Drawdowns
PGDP Phase II Site Investigation

Figure C-2 of Attachment C shows the coefficients s/Q plotted against flow rate. A best-fit line is drawn through the points from which the coefficients B and C can be derived according to the following straight-line equation:

$$s/Q = CQ + B$$

where

B = the y-intercept
C = the slope of the line
Q = pumping rate (gpm)
s = drawdown (ft).

For the best-fit line drawn, B = .128 and C = 8.6 x 10-4. The ratio of laminar head loss to the total head loss expressed as a percentage is found by:

$$L = (BQ / (BQ + CQ)) \times 100$$

where

L = the total head loss attributable to laminar flow.

Assuming a flow rate of 92 gpm, the percentage of laminar head loss to total head loss for the pumping well used in the pumping test equals 62 percent.

The well efficiency is expressed by Walton (1963) as the ratio of the actual specific capacity to the theoretical specific capacity. The theoretical specific capacity can be estimated from the nonequilibrium well equation (Cooper and Jacob, 1946):

$$s = (264Q \times \log(.3Tt/r^2S))/T$$

where

s = drawdown in the well in ft
Q = yield in the well, in gpm
T = transmissivity of the well in gpd/ft
t = time of pumping in days
r = radius of the well in feet
S = storage coefficient of the aquifer

By rearranging the terms, the specific capacity in gpm/ft is:

$$Q/s = T/264x\log(.3Tt/r^2S)$$

The theoretical specific capacity can be derived by substituting representative values of transmissivity and storativity into the above equation. The theoretical capacity is calculated for 1 day of pumping by substituting .5 ft for r and using the mean transmissivity and storativity derived from the log/log drawdown and recovery plots as discussed in the constant-rate pumping test section. The average transmissivity and storativity from both the drawdown and recovery analysis was 48,539 gpd/ft and .015, respectively. The theoretical specific capacity is 27.9 gpm/ft of drawdown. After pumping PW-1 at 92 gpm for 1 day, the actual drawdown is 17 feet. This equates to a specific capacity in PW-1 of 5.4 gpm/ft of drawdown. Efficiency as defined by Walton is thus approximately 20 percent. This low efficiency value may indicate that much of the drawdown is attributed to poor well construction or lack of development.

CONSTANT RATE PUMPING TEST

Time-Drawdown Log/Log Plots

Time-drawdown series were created for each well using a utility program that subtracts the head values monitored after the start of pumping from the static levels measured just before the start of pumping. All drawdown plots used to calculate transmissivity and storativity were generated from series corrected for the influence of barometric pressure. The resulting drawdown values are plotted against time from the start of pumping. Drawdown vs time curves for each of the wells monitored are presented in Attachment D.

Time-drawdown data were manually matched to a family of type curves that model unsteady flow in leaky confined aquifers. These curves were selected because the RGA was thought to be at least partially confined by the overlying interbedded clays and silts. There were no indications from the shape of the drawdown curves that unconfined conditions were prevalent in the pumping test area. Unconfined conditions normally result in drawdown curves with two breaks. The first break represents the unconfined aquifer responding as a confined aquifer from which the transmissivity and elastic storativity can be derived. The second break represents the completion of gravity drainage, which is common in geologic complexes with low relative vertical conductivities. The second break normally occurs within the first few hours of pumping. Finally, the efficiency of the RGA wells in response to the barometric changes strongly suggests the RGA is at least partially confined.

The type curves used were developed by Cooper (1963) and obtained from Lohman (1978) (Attachment D). The method of curve matching the field data to these type curves allows for the approximation of the transmissivity, storativity and leakance of the leaky confined aquifer. This method is accurate, however, only when the hydraulic gradient throughout the confining bed adjusts instantaneously to the decline in head in the aquifer. This condition is generally true when (among other factors) the confining bed thickness is small or the rate of decline of head in the aquifer is slow. Even if these conditions do not persist in the confining layer, however, the use of the Cooper curves provide better approximations to aquifer transmissivity and storativity than the Theis curve alone when the results of a pumping test indicate that leakage occurs.

The curve matching technique required superimposing the field data time-drawdown series curve (t vs s) on top of the solid type curves. The coordinate axis of both graphs were kept parallel and a match made where the earliest data was coincident with W(u). Matches were carefully made to avoid inclusion of early time data, which may be influenced by casing storage and localized soils not necessarily representative of the aquifer. If the data did not plot directly on one of the solid type curves then interpolation was required. After a match was made, the coordinates of a convenient match point were selected (s,t,L(u,v), 1/u and v). The coordinates were then substituted into the following equations:

$$T = 114.6QL(u,v)/s,$$

$$S = Ttu/1.87r^2,$$

$$K'/b' = 4Tv^2/r^2$$

where

T = Transmissivity (gpd/ft)
S = Coefficient of storage
Q = Flow rate (gpm)

L(u,v)	=	The leaky well function of u
u	=	$1.87r^2S/Tt$
t	=	time since pumping started (days)
r	=	distance from pumping well to observation well
K	=	vertical conductivity of confining layer (ft/day)
b	=	thickness of confining layer (ft)
v	=	dimensionless parameter.

Curve matches were made for each of the RGA wells PZ-1 through PZ-5. None of the shallow piezometers developed drawdown curves suitable for matching. The same is true for MW-165 and MW-166. Furthermore, it is not appropriate to match the shallow piezometer curves because of their apparent disconnection with the RGA. Although MW-165 is an RGA well, its position was not close enough to the pumping center to result in a drawdown pattern suitable for matching. The influence of barometric changes and heterogeneities in the aquifer caused enough fluctuations in the drawdown series to prohibit useful curve matching.

The drawdown curve for PW-1 Defunct is a straight line with a slope of 1 to 1. This response is probably the result of a reduction in casing storage during the pumping test. The delayed drawdown indicates that PW-1 Defunct is probably "screened" in the shallow groundwater system.

The match points generated from each of the curve matches are included on the actual field curves for gravel piezometers PZ-1G through PZ-5G. The match points are shown on the drawdown curves in Attachment D. The match point coordinates, resulting transmissivities, storativities, and leakance values are presented in Table 7-4. Drawdown curves for each of the shallow piezometers, MW-165 and MW-166 and MW-163 and MW-164, are also included in Attachment D.

The transmissivities for all piezometers except PZ-4G average 45,917 gpd/ft and range from 43,920 gpd/ft in PZ-3G and PZ-5G to 47,913 gpd/ft in PZ-1G and PZ-2G. Storativities range from 0.006 in PZ-1G to 0.061 in PZ-3G, with a geometric mean of 0.015. The geometric mean of leakance is .0220 gpd/ft^3. The considerably lower transmissivity in PZ-4G may be attributed to localized deposits of low-permeability sediments. These sediments may not possess the same RGA characteristics that allow the well to recover as quickly from the capture of water as a result of pumping. These sediments may also act as a barrier to the re-supply of water from the region of the aquifer surrounding the well.

The lower transmissivity in PZ-4G may also be an artifact of piezometer construction. It is not possible to be certain that data obtained from each piezometer are representative of aquifer conditions. Complications associated with installing well screens in silty deposits often prevent perfect hydraulic communication with the aquifer being tested. Well PZ-4G was augered to the bottom of the RGA. This augering may

Table 7-4
Aquifer Coefficients From Log/Log Drawdown Matches
PGDP Phase II Site Investigation

Piezometer	L(u,v)	1/u	s (ft)	t (min)	v	r (ft)	T (gpd/ft)	T (ft^2/day)	S	k′/b′ gpd/ft^3
Drawdown										
PZ-1G	1	1	0.22	0.42	0.01	34.4	47,913	6,405	0.0063	0.0162
PZ-2G	1	1	0.22	0.26	0.005	23.5	47,913	6,405	0.0084	0.0087
PZ-3G	1	10	0.24	0.75	0.01	14.1	43,920	5,872	0.0615	0.0884
PZ-4G	1	1	1.1	80	0.3	31.6	9,583	1,281	0.2851	3.4547
PZ-5G	1	1	0.24	4	0.02	60.8	43,920	5,872	0.0176	0.0190
Mean Excluding PZ-4G							47,917	6,139		
Geometric Mean Excluding PZ-4G									0.0150	0.0220

have caused a skin to form on the borehole face, inhibiting continuity with the formation and accounting for the spurious data. The hole was backfilled by allowing surrounding formation material to collapse and fill the void. This may have undermined the confining beds just outside the borehole in the shallow groundwater system. Possible breaching of permeable deposits in the shallow groundwater system could increase the leakage to the regional groundwater system in the vicinity of PZ-4G.

The storativity values are abnormally high for an aquifer with a barometric efficiency of 100 percent. The high storativities may be an artifact of the skin effect, which would act to delay drawdown in the piezometers. In addition, barometric efficiencies of 100 percent are uncommon and may be the result of anomalous data.

Time-Drawdown Semi-Log Plots

Semi-log plots were generated from the time-drawdown series for analysis by the Cooper-Jacob (1946) straight-line method. The method is a simplification of the nonequilibrium well equation and is represented by:

$$T = \frac{264\,Q}{\Delta s}$$

where T = transmissivity in gpd/ft
Q = pumping rate (gpm)
Δs = change in drawdown per log cycle (ft)

Strict application of the Cooper-Jacob method precludes analysis of data from leaky aquifers. However, best-fit straight lines were carefully drawn across the data before the field curve departed from the Theis-type curve, as shown in the log-log curves. These data are theoretically yet to be influenced by leakage.

Semi-log plots were generated for piezometers PZ-1G through PZ-5G, except for PZ-4G and are included in Attachment E. Best-fit lines were drawn through the data, and delta s values were obtained. These values were inserted into the above equation and transmissivities were computed. The results are presented in Table 7-5.

As discussed, the log-log curve for PZ-4G suggests that it is partly disconnected from the RGA. Furthermore, the curve departs considerably from the Theis-type curve, suggesting that leakage is significant in this region of the aquifer. Accordingly, PZ-4G was not analyzed by this method.

Table 7-5 Cooper Jacob Straight-Line Fit Transmissivities PGDP Phase II Site Investigation			
Well	**s (ft)**	**T (gpd/ft)**	**T (ft^2/day)**
PZ-1G	0.48	50,600	6,765
PZ-2G	0.50	48,576	6,494
PZ-3G	0.80	30,360	4,059
PZ-5G	0.50	48,576	6,494

Distance-Drawdown

In a distance-drawdown analysis, the drawdown from each well at a different distance from the pumping well is plotted for a time, t. A semi-log plot of distance vs. drawdown should result in a straight line. This application, however, is valid only for isotropic and homogeneous aquifers.

A distance-drawdown plot was derived from the drawdown values for PZ-3G, PZ-4G, and PZ-5G. Drawdown values were obtained from the drawdown curves for each well at 1000 minutes of pumping. The drawdown values were then plotted for each piezometer at its respective distance from the pumping well. The distance-drawdown plot is shown in Attachment F. Connecting the drawdown values for each of the wells does not result in the classic straight line fit normally observed for distance-drawdown plots. This irregular line can be attributed to the erratic behavior of PZ-4G as a result of aquifer heterogeneity or well construction. A best-fit line, however, can be hand-drawn to estimate transmissivity by the following equation:

$$T = 528Q/s$$

(Driscoll, 1986)

where

T = transmissivity in gpd/ft
Q = flow rate in gpm
s = change in drawdown in feet per log cycle

The slope of the best-fit line of the distance-drawdown plot is 1.4 feet. Substituting into the above equation results in a transmissivity of 34,697 gpd/ft. It must be understood, however, that this value was derived from a best-fit line drawn with the knowledge that the data from PZ-4G are spurious.

Anisotropy

An evaluation of aquifer anisotropy was performed with the assumption that the lower transmissivity values observed in PZ-3G and PZ-5G are the result of anisotropy. The lower transmissivity values obtained from the log/log match analysis may in fact, be the result of either aquifer heterogeneity or an artifact of well construction. The shapes of the drawdown and recovery curves for PZ-4G are considerably different than that of the other curves, suggesting that different aquifer conditions exist around PZ-4G. This is a strong argument for heterogeneity, and not necessarily anisotropy, to account for the lower values in PZ-3G and PZ-5G. The depositional conditions that persisted during formation of the Lower Continental Deposits may, however, account for conditions of anisotropy. High-energy stream deposits resulted in the formation of elongated gravel lenses which locally extend in one direction. This structure could result in anisotropic conditions.

Conditions of anisotropy were evaluated using software developed by In-Situ, Inc. (1987), called Papodop. The software incorporates the method developed by Papodopolous (1965) for nonsteady flow in an infinite anisotropic aquifer. The method solves for the magnitude and orientation of the maximum and minimum conductivity directions which exist in anisotropic aquifers. The theory uses the Laplace transformation and is ultimately solved with a system of simultaneous equations. The theory is summarized in Attachment G.

Papodop executes the analysis by accepting the data for at least three test wells at different distances and directions from the pumping well. The well field must be identified in an XY coordinate system with the pumping well considered the origin. The program prompts for the x,y coordinates, the match-point coordinates and the flow-rate and outputs the transmissivity, storativity and leakance values for each well. The output also includes the maximum transmissivity, minimum transmissivity, and the direction of the maximum transmissivity.

Only the match-point data from PZ-1G, PZ-2G, PZ-3G and PZ-5G were input to the program. When the data for PZ-4G were input, the program responded by rejecting any three well combination including this piezometer. The program requires consistency in storativity values among the match points. The storativity for PZ-4G, however is significantly greater than that for the other wells. Furthermore, as discussed, the transmissivity value for PZ-4G is far below the results for the other piezometers.

Output from Papodop are included in Attachment G . The major transmissivity is 65,409 gpd/ft. The minor transmissivity is 32,182 gpd/ft. The direction of the major transmissivity is nearly due east.

According to Hantush (1966) the shape of the equal drawdown ellipse is dictated by the following relationship:

$$a/b = (Tx / Ty)^{1/2}$$

where

- a = the length of the major axis
- b = the length of the minor axis
- Tx = Major Transmissivity
- Ty = Minor Transmissivity

The ratio of a to b is 1.4 by the expression above. Figure 7-3 illustrates the shape and orientation of the cone of equal drawdown that could occur in the vicinity of the pumping test area based on the above relationship. This ellipse does not represent the cone of depression resulting from a particular flow-rate after time (t). It simply presents the shape and direction of the equal drawdown ellipse.

The equal shape and direction of the equal drawdown ellipse is only as valid as the transmissivity data input to the Papodopolous solution. The figure is meant only as a possible depiction of drawdown conditions that would result if the lower transmissivity values in PZ-3G and PZ-5G are in fact the result of anisotropy.

RECOVERY TEST

The recovery series was generated by subtracting the head value recorded just before the pump was stopped from each of the subsequent values. This series was plotted against the time since pumping stopped. Recovery plots were done for piezometers PZ-1G through PZ-5G. Each recovery series used to generate coefficients of transmissivity and storativity were corrected for barometric pressure fluctuations. The recovery plots are included in Attachment H. The match-points and their values are included on the recovery plots for each of these piezometers. The resulting aquifer coefficients are presented in Table 7-6.

The transmissivities from the recovery matches, excluding PZ-4G, range from 45,830 gpd/ft in PZ-3G to 52,704 gpd/ft in PZ-1G and average 49,160 gpd/ft. Storativities range from 0.0084 in PZ-2G to 0.033 in PZ-1G and have a geometric mean of .015. The geometric mean of the leakance values is .0300 gpd/ft^3.

Table 7-6
Aquifer Coefficients From Log/Log Recovery Matches
PGDP Phase II Site Investigation

Piezometer	L(u,v)	1/u	s (ft)	t (min)	v	r (ft)	T (gpd/ft)	T (ft^2/day)	S	k´/b´ gpd/ft^3
Drawdown										
PZ-1G	1	1	0.2	2	0.01	34.4	52,704	7,046	0.0331	0.0178
PZ-2G	1	1	0.21	0.25	0.01	23.5	50,194	6,710	0.0084	0.0364
PZ-3G	1	10	0.23	0.15	0.005	14.1	45,830	6,127	0.0128	0.0231
PZ-4G	1	1	1.3	110	0.4	31.6	8,108	1,084	0.3317	5.1968
PZ-5G	1	1	0.22	3.8	0.03	60.8	47,913	6,405	0.0183	0.0467
				Mean Excluding PZ-4G			49,160	6,843		
				Geometric Mean Excluding PZ-4G					0.0160	0.0300

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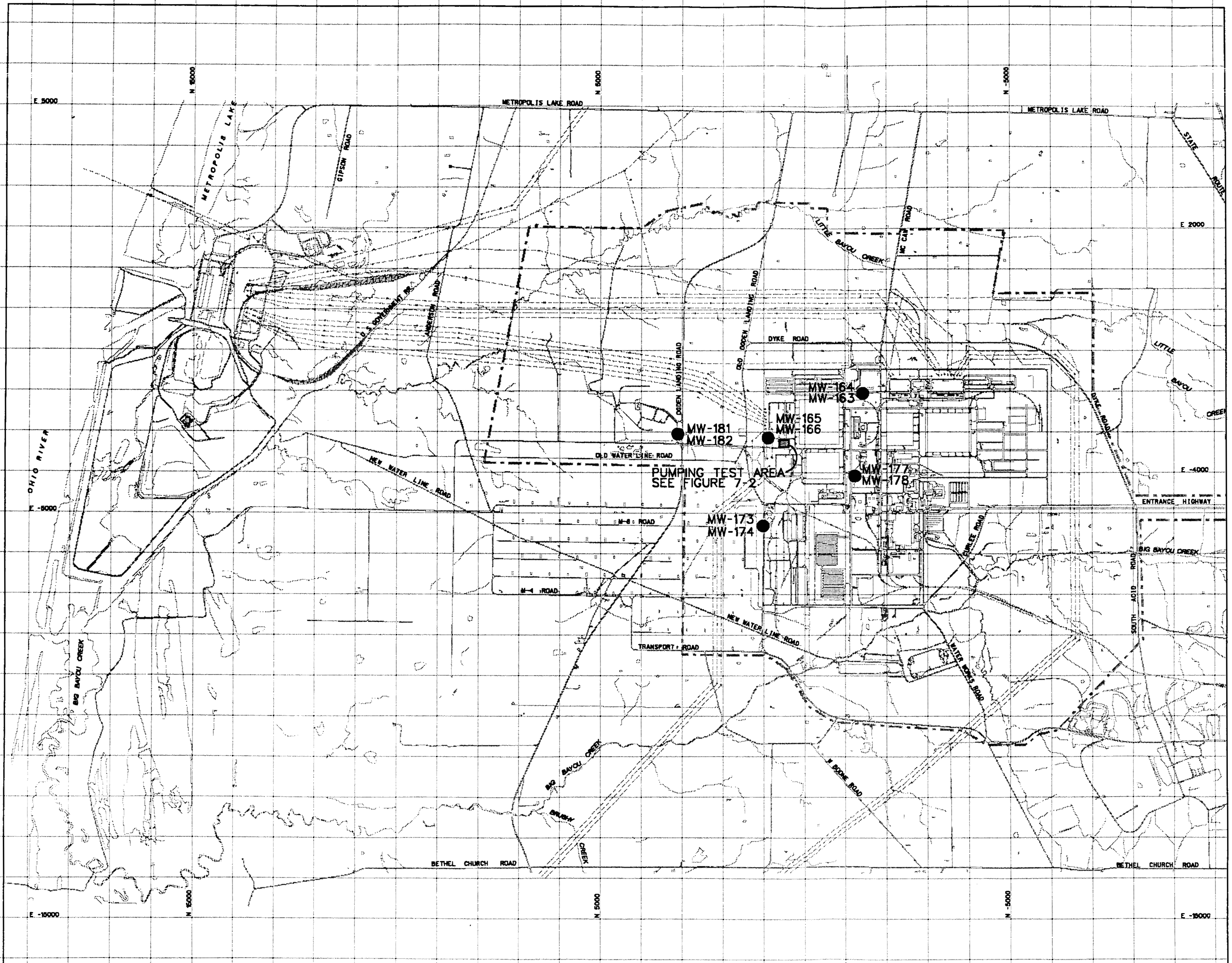


REVIEWED FOR CLASSIFICATION

WS 7/9/03

Initials Date

UNCLASSIFIED

LEGEND

- ● MW-163 — PHASE II MONITORING WELLS
- ▪ — PUMPING TEST LOCATION

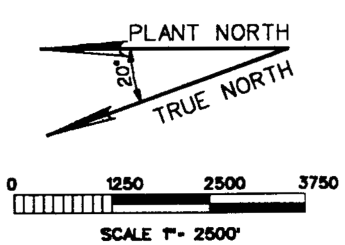


Figure 7-1

MONITORING WELL LOCATIONS FOR THE PUMPING TEST

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KY.

PHASE II SITE INVESTIGATION

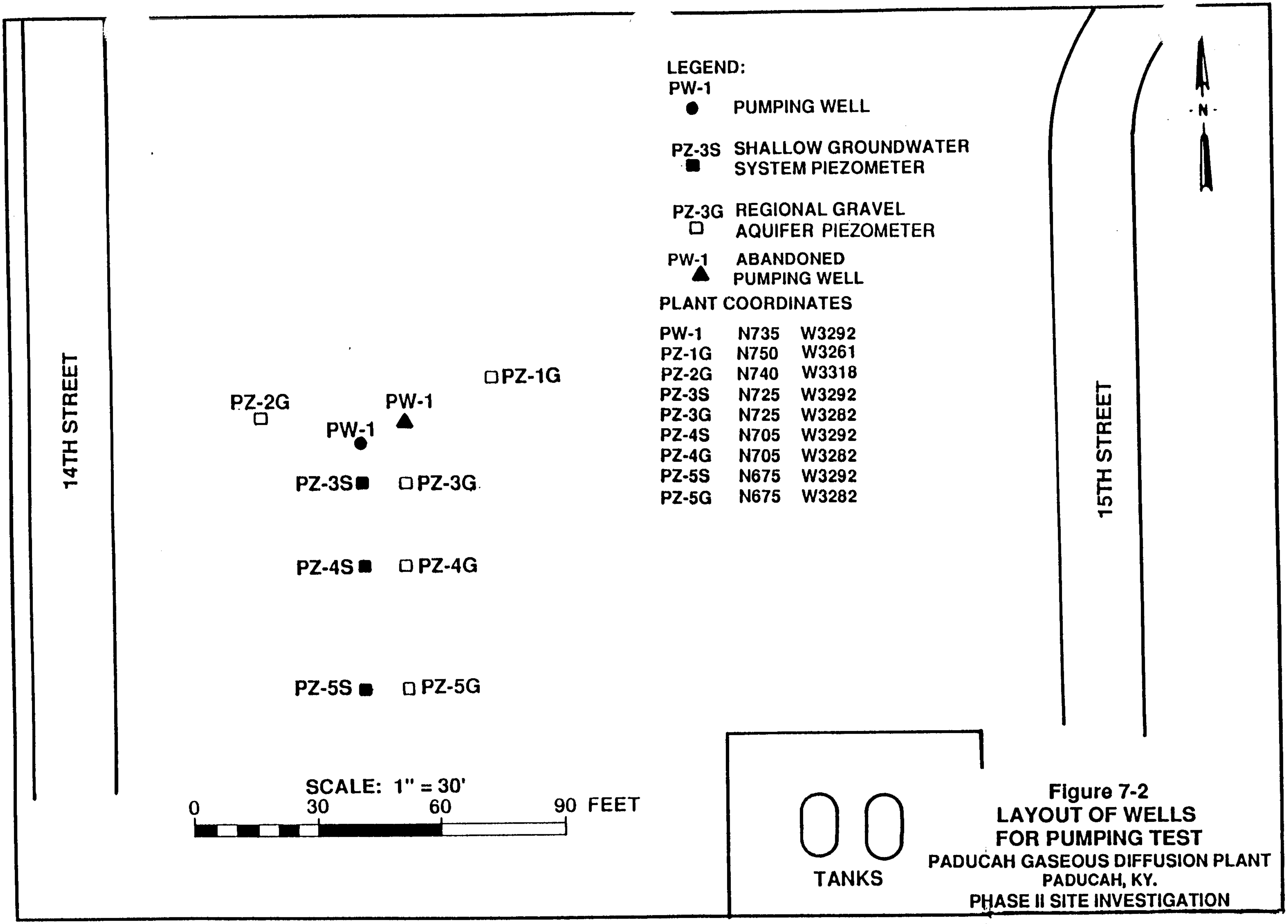


Figure 7-2
LAYOUT OF WELLS FOR PUMPING TEST
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

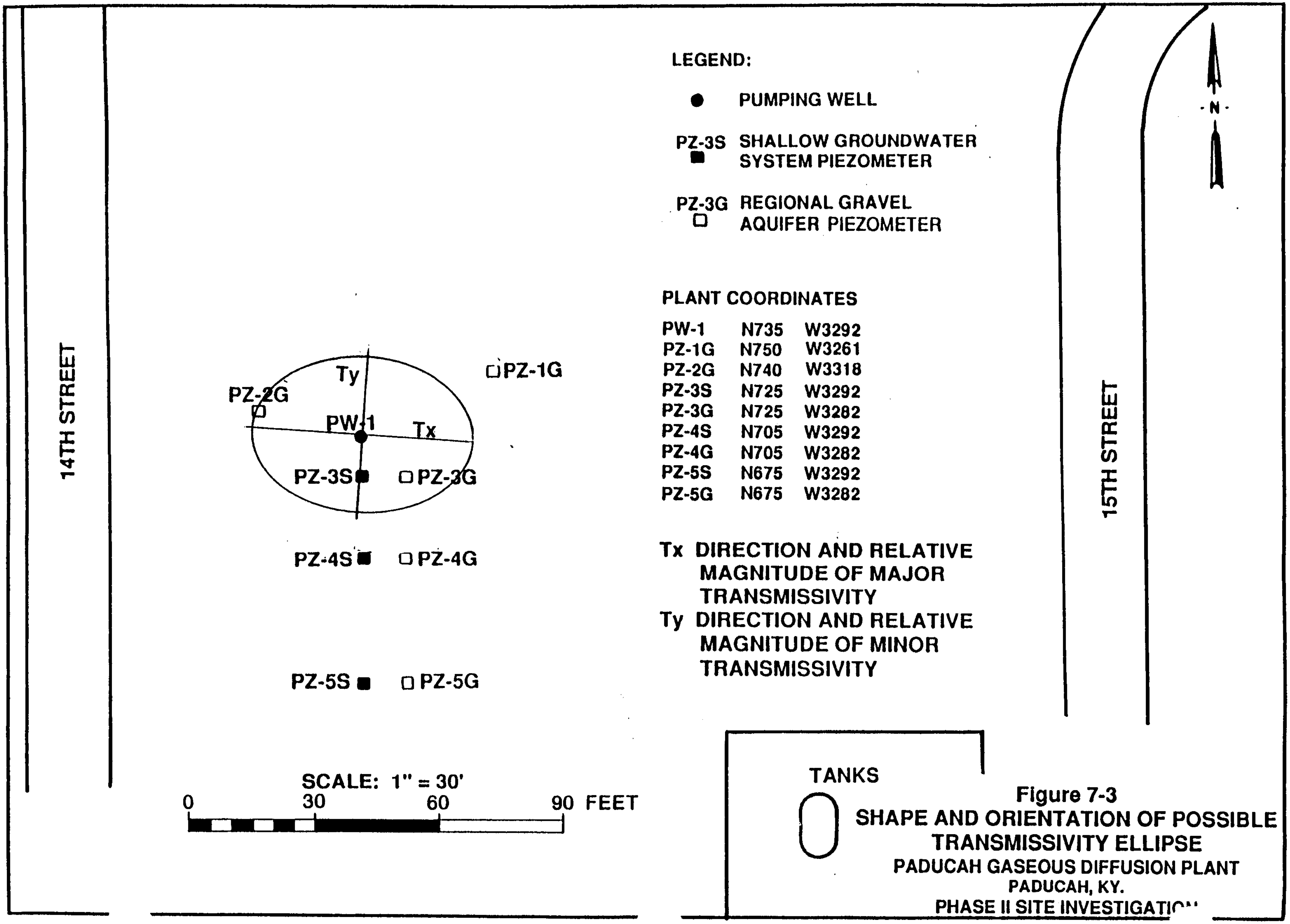


Figure 7-3
SHAPE AND ORIENTATION OF POSSIBLE TRANSMISSIVITY ELLIPSE
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY.
PHASE II SITE INVESTIGATION

Attachment A

WELL CONSTRUCTION DIAGRAMS AND BORING LOGS

PZ-3S

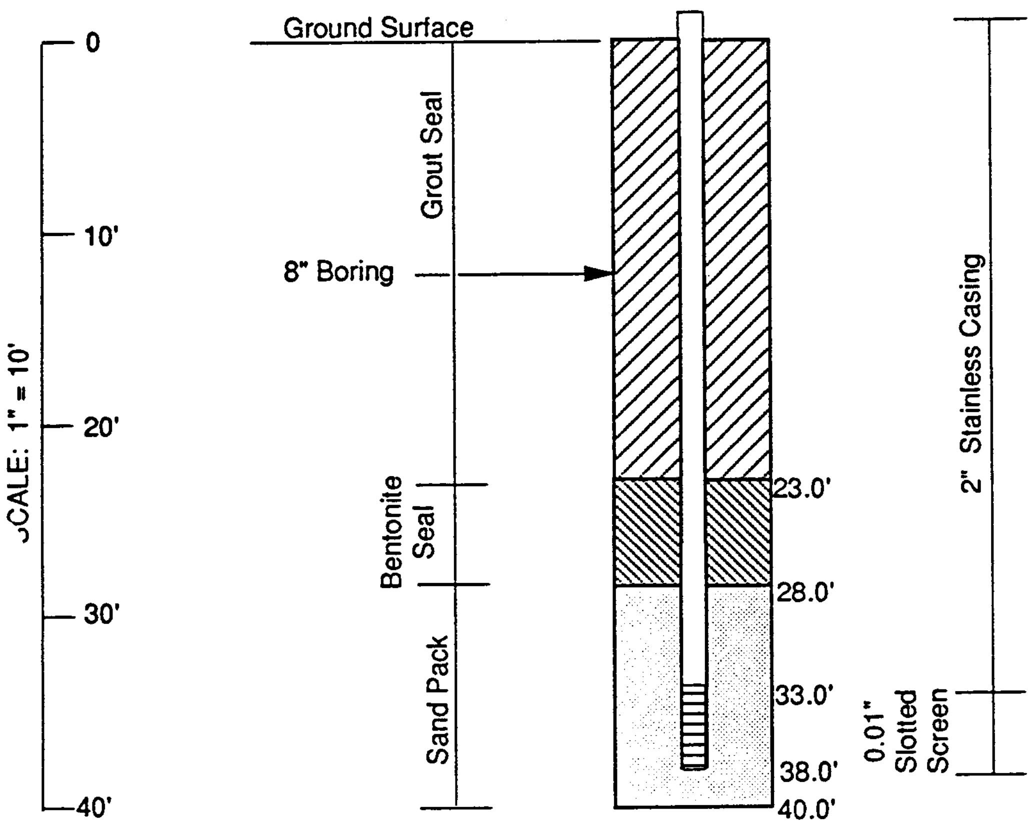


Figure 7A-1
PZ-3S
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

PZ-4S

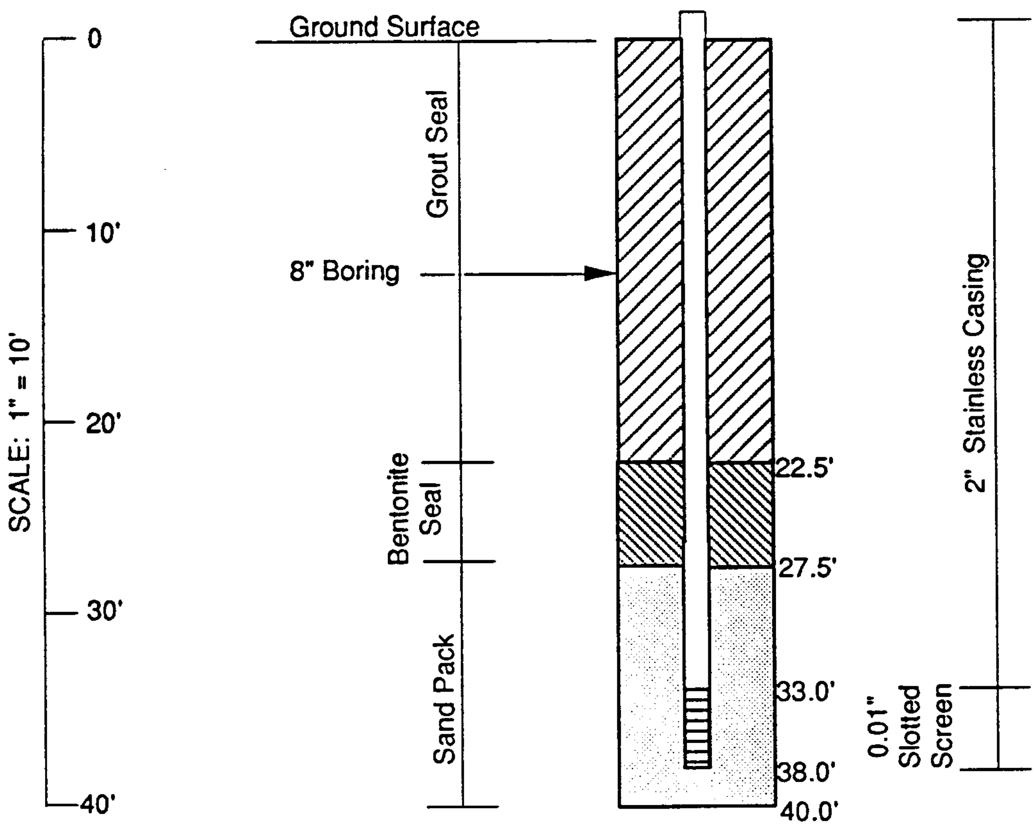


Figure 7A-2
PZ-4S
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

PZ-5S

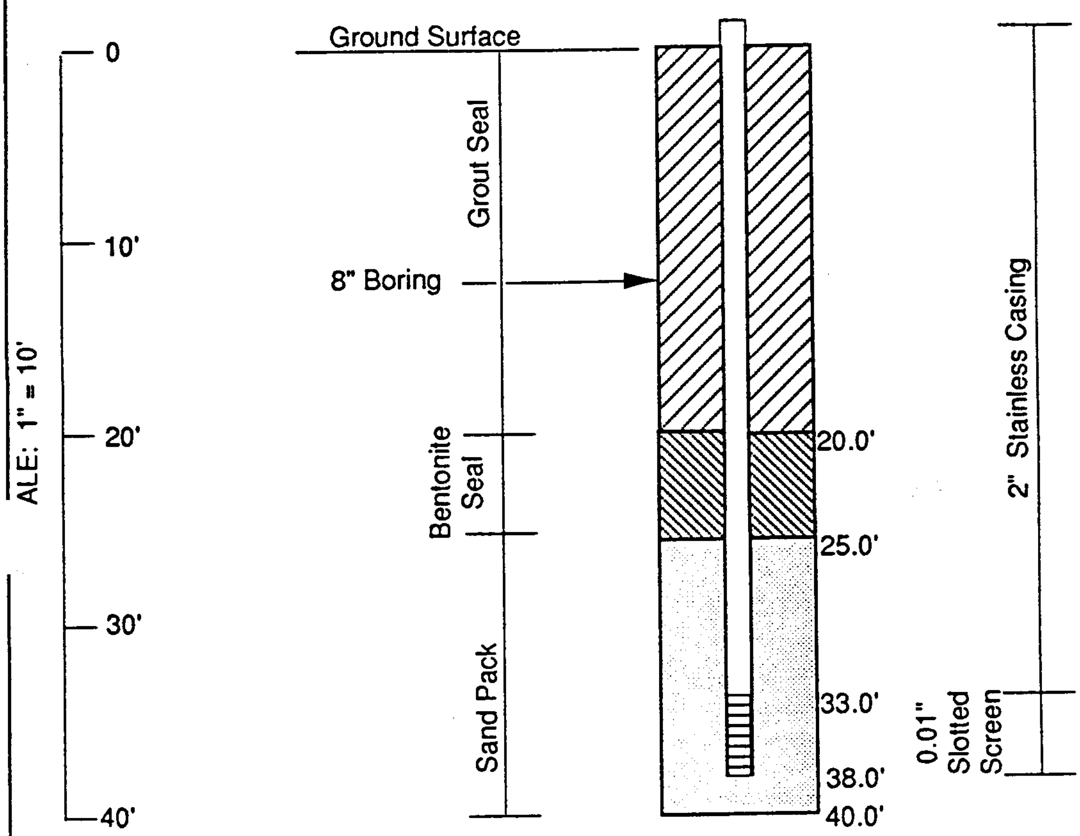


Figure 7A-3
PZ-5S
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

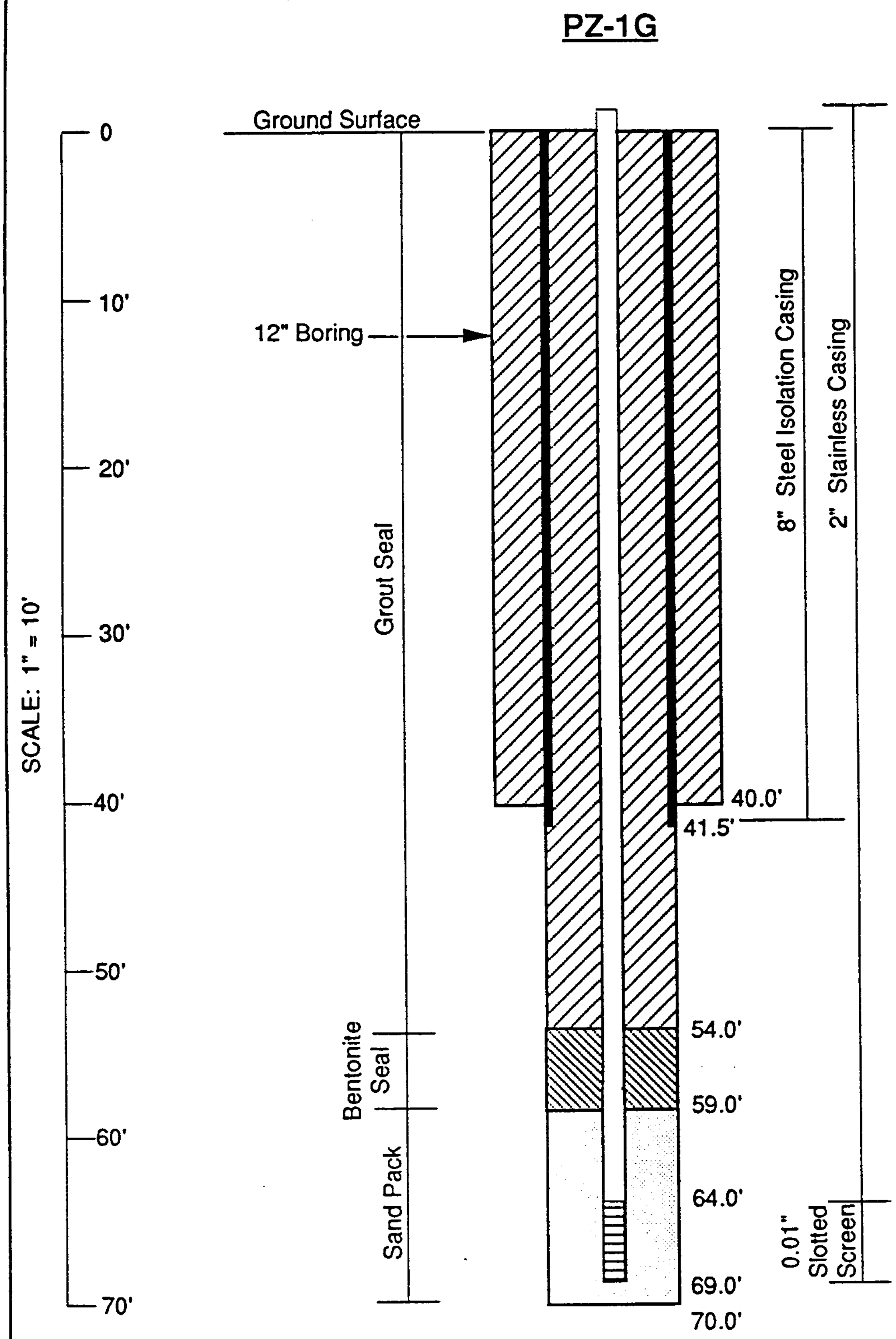


Figure 7A-4
PZ-1G
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

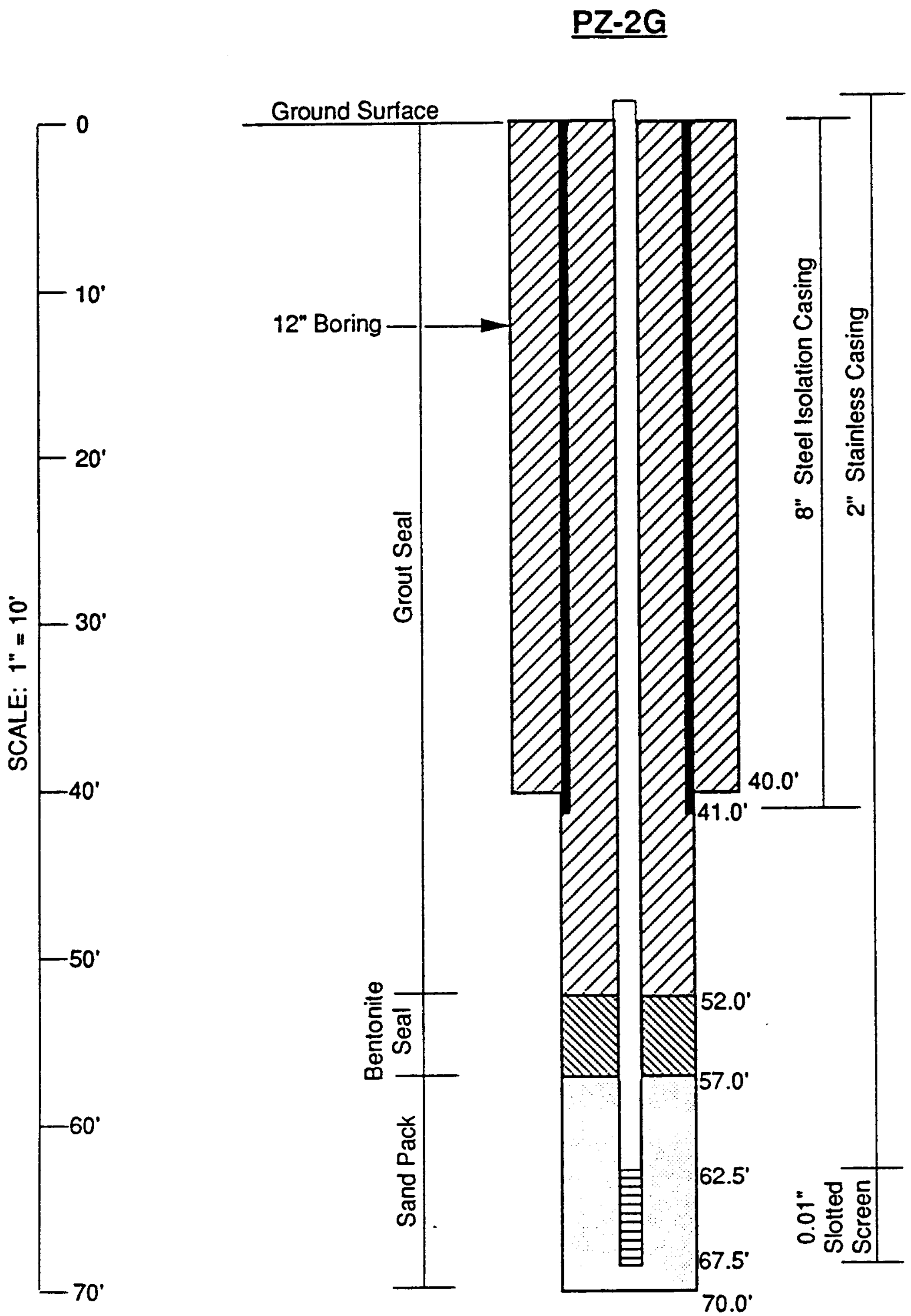


Figure 7A-5
PZ-2G
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

PZ-3G

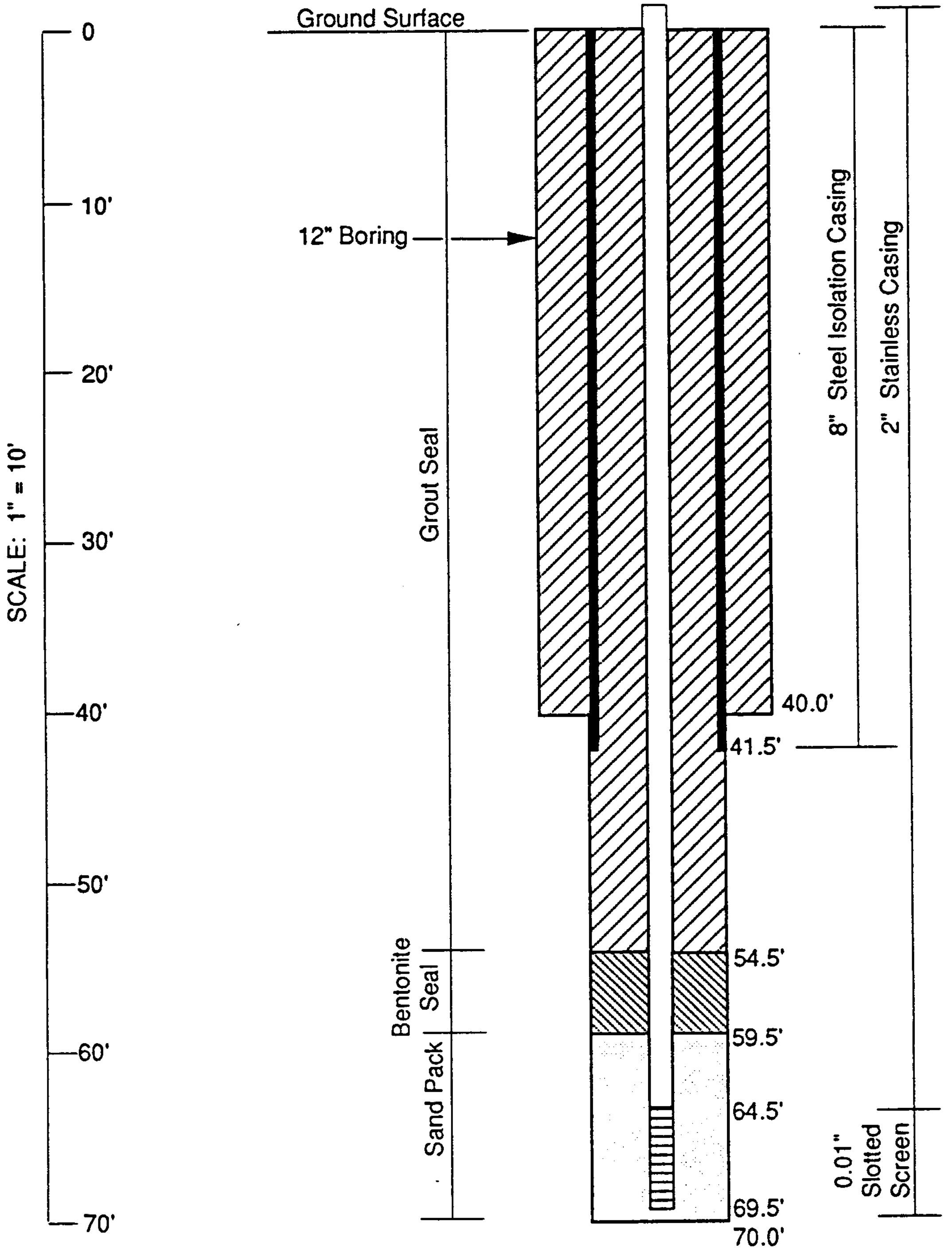


Figure 7A-6
PZ-3G
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

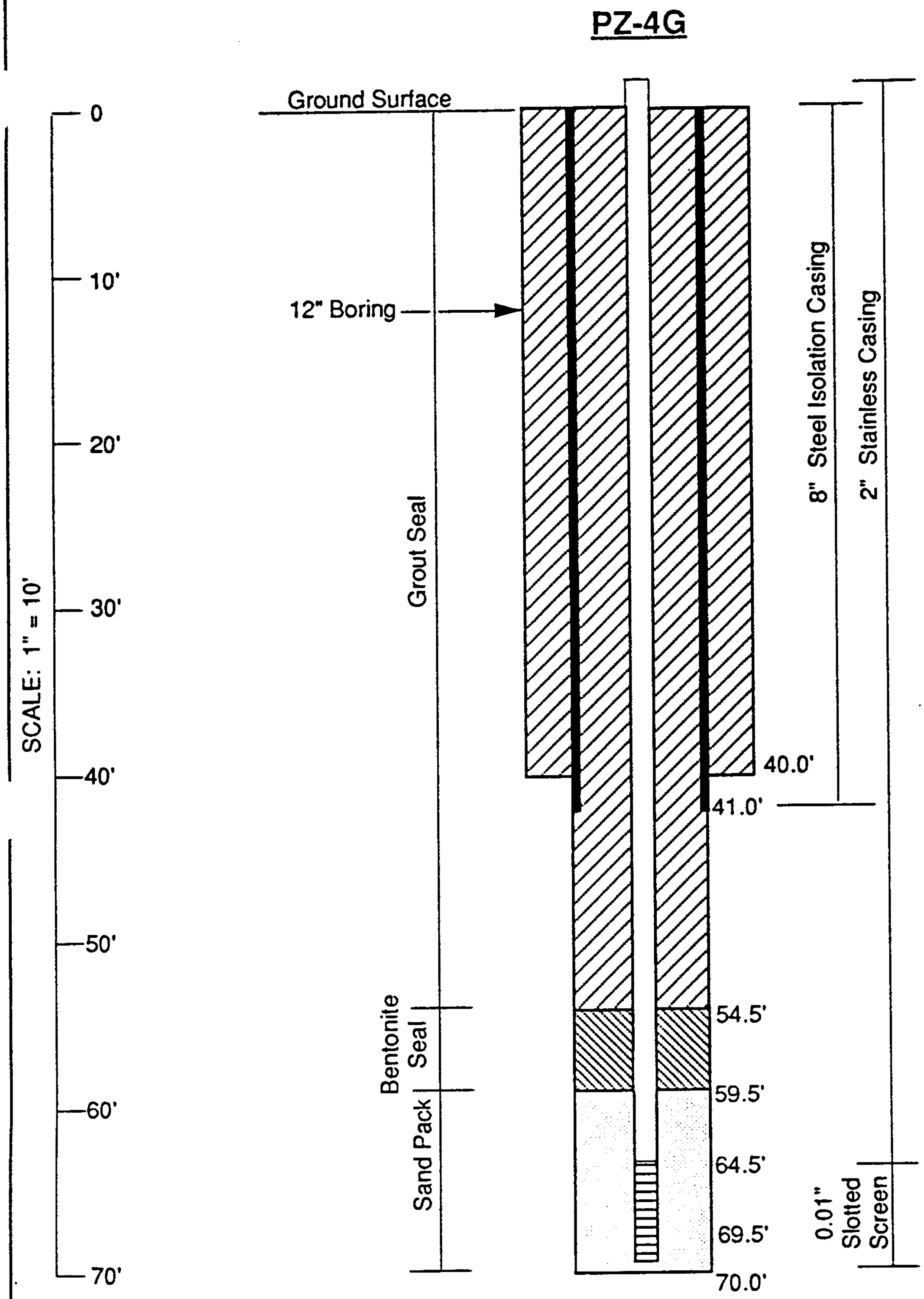


Figure 7A-7
PZ-4G
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

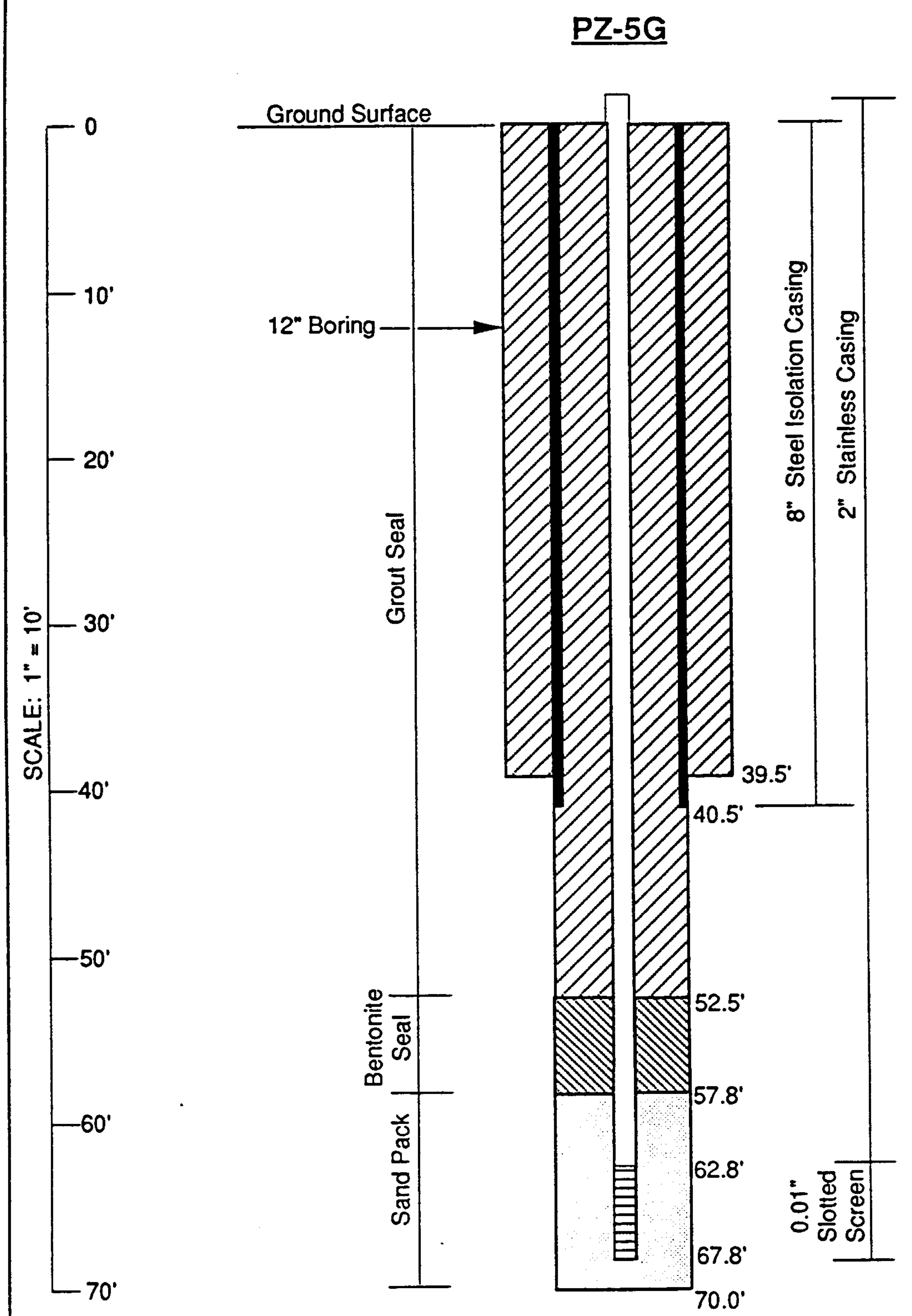


Figure 7A-8
PZ-5G
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

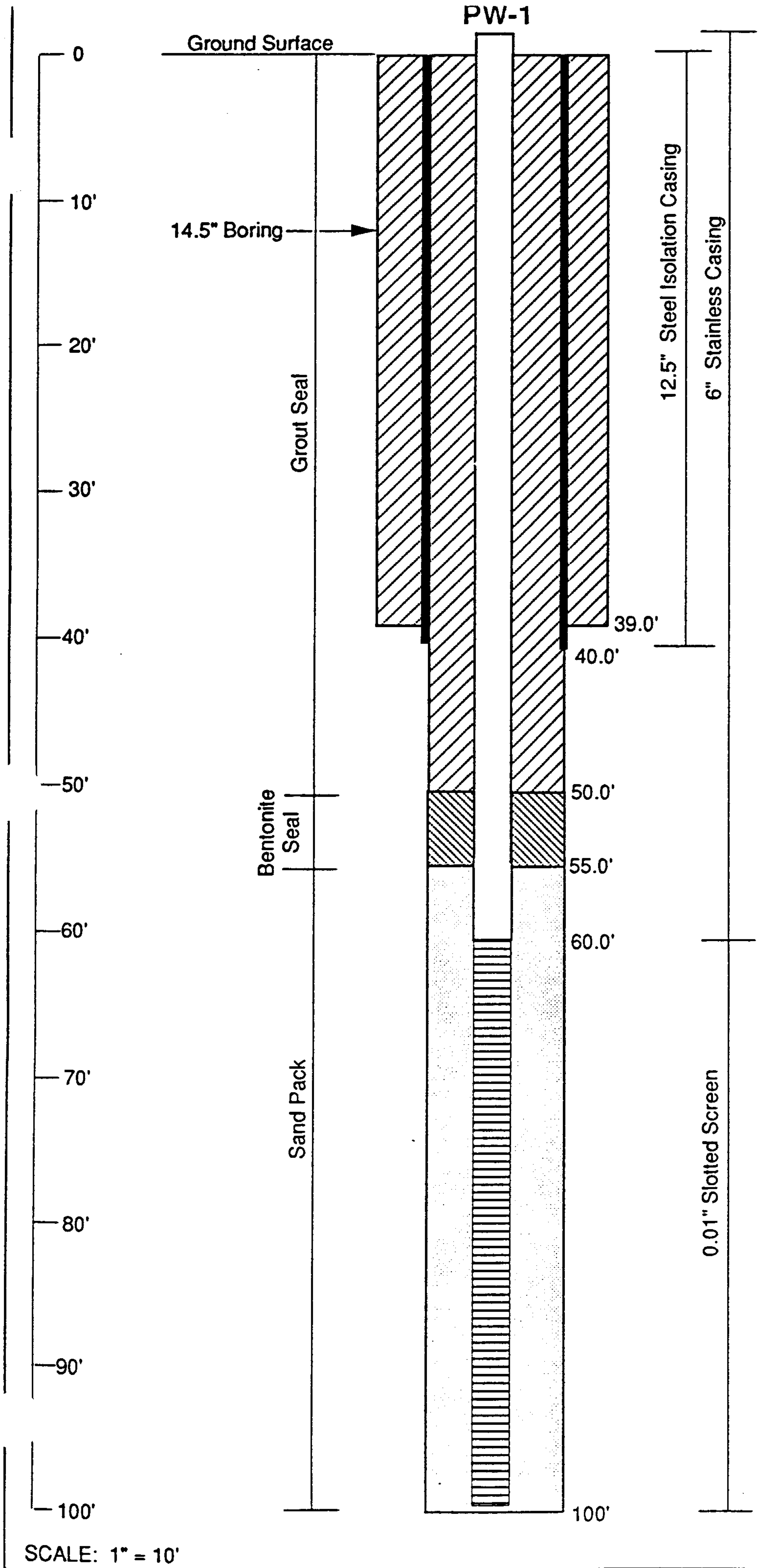


Figure 7A-9
PW-1
WELL CONSTRUCTION DETAIL
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ1	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Aquifer Pump Test

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/1/91 FINISH 5/2/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0-5	CME	1.1	N/A	LEAN CLAY (CL), dark yellowish brown (10 YR 4/2), moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 2.5 kg/cm^2
5	5-10	CME	5.0	N/A	LEAN CLAY (CL), moderate yellowish brown (10 YR 5/2) with mottling, moist, soft		HNu = 0 ppm Rad = 30 cpm P.P. = .5 kg/cm^2
10	10-15	CME	5.0	N/A	LEAN CLAY (CL), same as above, stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 1.5 kg/cm^2
15	15-20	CME	5.0	N/A	LEAN CLAY (CL), same as above except more gray (NS), very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 3.0 kg/cm^2
20	20-25	CME	5.0	N/A	SANDY LEAN CLAY (CL), light brown (5 YR 5/6) with mottling, moist, hard, sand fine grained		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
25	25-30	CME	5.0	N/A	SANDY LEAN CLAY (CL), same as above except moderate reddish brown (10 YR 4/6), very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.0 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ1	SHEET 2 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: Aquifer Pump Test

ELEVATION: DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 5/1/91 FINISH: 5/2/91 LOGGER: D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	CME	5.0	N/A	SANDY LEAN CLAY (CL), moderate yellowish brown (10 YR 5/2), moist except for top 1.5' which is wet, soft-stiff fine sand		HNu = 0 ppm Rad = 30 cpm P.P. = .5-1.5 kg/cm^2
35	35-40	CME	4.0	N/A	Top 1.5' : SANDY LEAN CLAY (CL), same as above Bottom 2.5" : LEAN CLAY W/TRACE SAND (CL), moderate reddish brown (10 R 4/6) with mottling moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.0-3.5 kg/cm^2
40	40-45	CME	5.0	N/A	SANDY LEAN CLAY (CL), moderate reddish brown (10 R 4/6) , moist, sand fine grained and micaeous (30-40% sand), soft		HNu = 0 ppm Rad = 30 cpm P.P. = .5 kg/cm^2
45	45-50	CME	4.1	N/A	SANDY LEAN CLAY (CL), same as above except 50% sand		HNu = 0 ppm Rad = 30 cpm P.P. = .5 kg/cm^2
50	50-55	CME	2.6	N/A	POORLY GRADED SAND (SP), moderate reddish brown (10 R 4/6) moist, medium to fine grained, micaeous		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
55	55-60	CME	1.5	N/A	WELL GRADED SAND W/GRAVEL (SW),moderate yellowish brown, sand medium, gravel subangular, wet		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
60							

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ1	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Aquifer Pump Test

ELEVATION DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/1/91 FINISH 5/2/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	CME	1.4	N/A	WELL GRADED SAND (SW), with some gravel, moderate yellowish brown (10 YR 5/4) wet, sand fine, coarse grained, gravel subrounded		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
65	65-70	CME	0.0	N/A	No sample. 2' of heave in the sampler		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
70					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ2	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: PGDP Phase II Site Investigation LOCATION: Aquifer Test Area

ELEVATION: ______ DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A START: 5/14/91 FINISH: 5/15/91 LOGGER: G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Bkgd: HNu=0 ppm; Rad=35 cpm
	0-5	CME	0.0	N/A	No Recovery		HNu = 0 ppm Rad = 35 cpm Pocket Pen (P.P.) = N/A No recovery possible due to gravel catcher in end of sampler
5	5-10	CME	1.7	N/A	LEAN CLAY (CL), dark gray (N3) wet, very soft		HNu = 0 ppm Rad = 35 cpm P.P. = <0.25 kg/cm^2
10	10-15	CME	1.0	N/A	LEAN CLAY (CL), dark gray (N3) with moderate brown (5 YR 4/4) streaking, wet, soft		HNu = 0 ppm Rad = 35 cpm P.P. = 0.5 kg/cm^2
15	15-20	CME	4.6	N/A	LEAN CLAY (CL), same as above except with some black (N1) mottling, and very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 2.5 kg/cm^2
20	20-25	CME	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6) moist, very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 4.0 kg/cm^2
25	25-30	CME	4.0	N/A	LEAN CLAY (CL), same as above except hard		HNu = 0 ppm Rad = 35 cpm P.P. = 4.25 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ2	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Aquifer Test Area

ELEVATION DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig: 7-3/4" OD CME Augers: 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/14/91 FINISH 5/15/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	CME	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6) with light gray (N7) mottling, moist, stiff, some sand with clay		HNu = 0 ppm Rad = 35 cpm P.P. = 4.0 kg/cm^2
35	35-40	CME	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6) to moderate red (5 YR 4/6) moist, very stiff		HNu = 0 ppm Rad = P.P. = 4.0 kg/cm^2 setting isolation casing @ 40' bgs
40	40-45	CME	5.0	N/A	LEAN CLAY (CL), light brown (5 YR 5/6) to light gray (N7), moist, very stiff		HNu = 0 ppm Rad = 35 cpm P.P. = 3.75 kg/cm^2
45	45-50	CME	2.8	N/A	LEAN CLAY W/ SAND (CL), moderate brown (5 YR 3/4) to light gray (N7), wet, very stiff, fine to medium grained sand		HNu = 0 ppm Rad = 35 cpm P.P. = 2.75 kg/cm^2
50	50-55	CME	3.7	N/A	0.9' : LEAN CLAY W/ SAND (CL), same as above 2.8' : WELL GRADED GRAVEL W/SAND (GW), moderate brown (5 YR 4/4) wet, subrounded gravel, fine to coarse sand		HNu = 0 ppm Rad = 35 cpm P.P. = 2.75 kg/cm^2 for CL
55	55-60	CME	1.4	N/A	WELL GRADED GRAVEL W/ SAND (GW), same as above		HNu = 0 ppm Rad = 35 cpm P.P. = N/A
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ2	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Aquifer Test Area

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/14/91 FINISH 5/15/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	CME	0.0	N/A	No Recovery		HNu = 0 ppm Rad = N/A P.P. = N/A rig chatter
65	65-70	CME	0.0	N/A	No Recovery		HNu = 0 ppm Rad = N/A P.P. = N/A rig chatter
70					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BI	PZ3G	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 54' bgs START 13:30, 4/10/91 FINISH 15:13, 4/11/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Gravel fill, angular L.S.		Bkgd: HNu=0 ppm; Rad=28 cpm
	0-5	N/A	2.5	N/A	LEAN CLAY W/ SAND (CL), moderate yellowish brown (10 YR 5/4), hard, slightly moist, crumbles		HNu = 0 ppm Rad = 56 cpm Pocket Pen (P.P.) = >4.5 kg/cm^2
5	5-10	N/A	5.0	N/A	LEAN CLAY (CL), brownish gray (5 YR 4/1), soft, moist, plastic		HNu = 0 ppm Rad = 40 cpm P.P. = 0.5-2.25 kg/cm^2
					LEAN CLAY W/ SAND (CL), mottled pale yellowish brown (10 YR 6/2) and light gray (N7), slightly moist, stiff		
10	10-15	N/A	5.0	N/A	LEAN CLAY W/ SAND (CL), mottled pale yellowish brown (10 YR 6/2) and light gray (N7), and moderate yellowish brown (10 YR 6/6), ferrous nodules, very stiff, crumbles		HNu = 0 ppm Rad = 37 cpm P.P. = 2.5-3.0 kg/cm^2
15	15-20	N/A	5.0	N/A			HNu = 0 ppm Rad = 46 cpm P.P. = 1.75-2.5 kg/cm^2
					LEAN CLAY W/ SAND (CL), light brownish gray (5 YR 6/1), stiff, slightly moist, crumbles		
20	20-25	N/A	5.0	N/A	LEAN CLAY W/ SAND (CL), same as above except mottled with moderate yellowish brown (10 YR 6/2)		HNu = 0 ppm Rad = 22 cpm P.P. = 2.75-3.25 kg/cm^2
25	25-30	N/A	5.0	N/A	SANDY LEAN CLAY W/ SAND (CL), moderate yellowish brown (10 YR 5/4), stiff, moist, crumbles		HNu = 0 ppm Rad = 21 cpm P.P. = 1.25-4.25 kg/cm^2
					CLAYEY SAND W/GRAVEL (SC), subangular, moderate brown (5 YR 4/4), moist		
30					SANDY LEAN CLAY (CL), mottled pale yellowish brown and gray, very stiff, moist, plastic		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BI	PZ3G	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ____ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 54' bgs START 13:30, 4/10/91 FINISH 15:13, 4/11/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	N/A	5.0	N/A	SANDY LEAN CLAY (CL), moderate yellowish brown (10 YR 5/2), mottled with light gray (N7), stiff, wet, plastic		HNu = 0 ppm Rad = 40 cpm Pocket Pen. = 0.75-3.5 kg/cm^2
					CLAYEY SAND (SC), moderate yellowish brown (10 YR 5/4), very moist, plastic		
35	35-40	N/A	5.0	N/A	SANDY LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and medium gray (N5), ferrous nodules, stiff, slightly moist, crumbles		HNu = 0 ppm Rad = 40 cpm P.P. = 0.5-3.0 kg/cm^2 stopped drilling to set casing at 14:20
					SANDY LEAN CLAY (CL), same as above, except very moist to wet probably due to downhole water collected from grouting		
40	40-45	N/A	5.0	N/A			Resumed drilling 4/11/91 at 13:45 HNu = 0 ppm Rad = 26 cpm P.P. = 0->4.5 kg/cm^2
					SANDY LEAN CLAY (CL), moderate brown (5 YR 4/4), moist, hard, crumbles		
45	45-50	N/A	5.0	N/A			HNu = 0 ppm Rad = 45 cpm P.P. = 1.0-2.5 kg/cm^2
					SANDY LEAN CLAY (CL), trace gravel, moderate brown mottled with gray, moist, stiff, brittle		
					POORLY GRADED SAND W/ CLAY(SA-SC), moist, light gray (N7)		
50	50-55	N/A	3.5	N/A	POORLY GRADED SAND W/ CLAY (SP-SC), mottled moderate brown (5 YR 4/4) and light gray (N7), stiff, moist, some ferrous material		HNu = 0 ppm Rad = 56 cpm P.P. = 1.5-1.75 kg/cm^2
55	55-60	N/A	0.5	N/A	WELL GRADED GRAVEL W/ SAND (GW), moderate brown (5 YR 4/4), well graded sand, subangular gravel up to 1.5" dia., wet		HNu = 0 ppm Rad = 30 cpm P.P. = 0 kg/cm^2
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BI	PZ3G	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ____ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 54' bgs START 13:30, 4/10/91 FINISH 15:13, 4/11/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	N/A	1.0	N/A	WELL GRADED GRAVEL W/ SAND (GW), moderate brown (5 YR 4/4), well graded sand,subangular to angular gravel up to 1.5" dia., wet		HNu = 0 ppm Rad = P.P. = 0
65	65-70	N/A	1.0	N/A	WELL GRADED GRAVEL W/ SAND (GW), same as above		HNu = 0 ppm Rad = P.P. = 0
70					End of Boring		

CH2M HILL

PROJECT NUMBER	BORING NUMBER
NJO30888.FA	PZ4G SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 30', approx. 57' aquifer START 15:56, 4/15/91 FINISH 13:48, 4/17/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Gravel fill, gray angular limestone		Bkgd: HNu=0 ppm; Rad=31 cpm
	0-5	N/A	2.5	N/A	LEAN CLAY (CL), moderate yellowish brown (10 YR 5/4), very stiff, moist, crumbles		HNu = 0 ppm Rad = 50 cpm Pocket Pen (P.P.) = 1.75-3.5 kg/cm^2 soil moist due to recent heavy rains
5	5-10	N/A	5.0	N/A	LEAN CLAY (CL), brownish gray (5 YR 4/1), soft, moist, plastic		HNu = 0 ppm Rad = 38 cpm P.P. = 0.75-1.5 kg/cm^2
					LEAN CLAY W/ SAND (CL), mottled pale yellowish brown (10 YR 6/2) and light gray (N7), slightly moist, stiff		
10	10-15	N/A	5.0	N/A	LEAN CLAY W/ SAND (CL), mottled pale yellowish brown (10 YR 6/2), light gray (N7), and moderate yellowish brown (10 YR 6/6), ferrous oxidation nodules, very stiff, crumbles		HNu = 0 ppm Rad = 33 cpm P.P. = 1.5-3.25 kg/cm^2
15	15-20	N/A	5.0	N/A	LEAN CLAY W/ SAND (CL), same as above except with increased oxidation, approximately 30% ferrous material		HNu = 0 ppm Rad = 26 cpm P.P. = 3.25->4.5 kg/cm^2
					LEAN CLAY W/ SAND (CL), light brownish gray (5 YR 6/1), stiff, slightly moist, crumbles		
20	20-25	N/A	5.0	N/A	LEAN CLAY W/ SAND (CL), same as above except mottled with moderate yellowish brown (10 YR 6/2)		HNu = 0 ppm Rad = 54 cpm P.P. = 2.0-4.0 kg/cm^2
25	25-30	N/A	5.0	N/A	SANDY LEAN CLAY (CL), modertae yellowish brown (10 YR 5/4), stiff, moist, crumbles		HNu = 0 ppm Rad = 42 cpm P.P. = 1.0-3.5 kg/cm^2
					CLAYEY SAND W/ GRAVEL (SC), subangular chert, moderate brown (10 YR 4/4), moist		
30					SANDY LEAN CLAY (CL), mottled pale yellowish brown and gray, very stiff, moist, plastic		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.FA	PZ4G	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ____ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 30', approx. 57' aquifer START 15:56, 4/15/91 FINISH 13:48, 4/17/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	N/A	5.0	N/A	SANDY LEAN CLAY (CL), moderate yellowish brown (10 YR 5/4), mottled with light gray (N7), stiff, wet, plastic		HNu = 0 ppm Rad = 32 cpm P.P. = 1.0-2.0 kg/cm^2
35					CLAYEY SAND (SC), moderate yellowish brown (10 YR 5/4), very moist, plastic		
	35-40	N/A	5.0	N/A	SANDY LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and medium gray (N5), ferrous nodules, stiff, moist, crumbles		HNu = 0 ppm Rad = 40 cpm P.P. = 0.5->4.5 kg/cm^2 16:40 Stopped drilling for the day
					WELL GRADED SAND W/CLAY AND GRAVEL (SW-SC), mottled moderate yellowish brown (10 YR 5/4)and medium gray (N5), subangular chert, moist		
40	40-45	N/A	3.5	N/A	SANDY LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and medium gray (N5), ferrous nodules, stiff moist, crumbles		Resumed drilling 13:00, 4/17/91, Rad Background = 22 cpm HNu = 0 ppm Rad = 44 cpm P.P. = 0->4.5 kg/cm^2 0 P.P due to wet clay from accumulated downhole water
45	45-50	N/A	5.0	N/A	SANDY LEAN CLAY (CL), moderate brown (5 YR 4/4), hard, moist, crumbles.		HNu = 0 ppm Rad = 32 cpm P.P. = 2.5-4.25 kg/cm^2
					SANDY LEAN CLAY (CL), mottled moderate brown (5 YR 4/4) and gray (N7), gray patches are well graded sand, trace chert gravel, moist, very stiff, crumbles, some ferrous material		
50	50-55	N/A	2.0	N/A	? ? ? ? ?		HNu = 0 ppm Rad = 29 cpm P.P. = 1.25-3.0 kg/cm^2
					WELL GRADED SAND (SW), moderate yellowish brown (10 YR 5/4), moist		
					POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC), mottled moderate brown (5 YR 4/4) and light gray (N7), stiff moist, large subrounded chert gravel up to 1" diameter		
55	55-60	N/A	2.0	N/A	? ? ? ? ?		HNu = 0 ppm Rad = 36 cpm P.P. = 0 kg/cm^2
					WELL GRADED GRAVEL W/ SAND (GW), moderate brown (5 YR 4/4), well graded sand, subangular gravel up to 1" diameter, wet		
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.FA	PZ4G	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 30', approx. 57' aquifer START 15:56, 4/15/91 FINISH 13:48, 4/17/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	N/A	2.0	N/A	WELL GRADED GRAVEL W/SAND (GW), moderate brown (5 YR 4/4), well graded sand, subangular chert gravel up to 1" diameter, wet		HNu = 0 ppm Rad = 29 cpm P.P. = 0 kg/cm^2
65	65-70	N/A	2.0	N/A	WELL GRADED GRAVEL W/SAND (GW), same as above, except with some subrounded gravel		HNu = 0 ppm Rad = 32 cpm P.P. = 0 kg/cm^2 stopped sampling @ 13:48 to drill to aquifer
70					End of Log Boring continued to 107'		Aquifer bottom is approximately 107 ' below ground surface according to drillers feel and rig action

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ5G	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE ______ START 12:30, 4/19/91 FINISH 10:23, 4/24/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Gravel Fill,angular limestone		Bkgd: HNu=0 ppm; Rad=40 cpm
	0-5	N/A Archive	4.5	N/A	LEAN CLAY W/SAND (CL), dark yellowish brown (10 YR 4/2), trace organics, hard, moist, crumbles LEAN CLAY (CL), moderate yellowish brown (10 YR 5/4) very stiff, moist, slightly plastic, some oxidized material		HNu = 0 ppm Rad = 46 cpm Pocket Pen (P.P.) = 2.5->4.5 kg/cm^2
5	5-10	N/A Archive	5.0	N/A	LEAN CLAY W/SAND (CL), mottled pale yellowish brown (10 YR 6/2) and light gray (N7), very stiff, moist, trace oxidized material		HNu = 0 ppm Rad = 42 cpm P.P. = 2.0-3.0 kg/cm^2
10	10-15	N/A Archive	5.0	N/A	LEAN CLAY W/SAND (CL), mottled pale yellowish brown (10 YR 6/2), light gray (N7), and moderate yellowish brown (10 YR 5/4), some ferrous oxide material, very stiff, moist, crumbles LEAN CLAY W/SAND (CL), same as above, except with increased oxidatioon, very oxidized in bottom 4"		HNu = 0 ppm Rad = 35 cpm P.P. = 1.75-3.0 kg/cm^2
15	15-20	N/A Archive	5.0	N/A	LEAN CLAY W/SAND (CL), mottled dark yellowish orange (10 YR 6/6) and light brownish gray (5 YR 6/1) stiff to hard, softer and more plastic toward bottom due to increased moisture		HNu = 0 ppm Rad = 34 cpm P.P. = 1.0-4.5 kg/cm^2
20	20-25	N/A Archive	5.0	N/A	LEAN CLAY W/SAND (CL), light brownish gray (5 YR 6/1), heavily oxidized 1/4-1/2" chunks, very stiff, moist, crumbles LEAN CLAY W/SAND (CL), light brownish gray (5 YR 6/1), mottled with dark yellowish orange (10 YR 6/6), and moderate yellowish brown (10 YR 5/6), stiff, moist, slightly plastic, some oxidation		HNu = 0 ppm Rad = 52 cpm P.P. = 0.5-3.25 kg/cm^2
25	25-30	N/A Archive	3.5	N/A	SANDY LEAN CLAY(CL), moderate yellowish brown (10 YR 5/4), mottled with light gray (N7), stiff, moist, crumbles CLAYEY SAND W/GRAVEL (SC), moderate brown (5 YR 4/4) subangular chert, moist, stiff, crumbles SANDY LEAN CLAY (CL), mottled pale yellowish brown and gray, very stiff, moist, plastic		HNu = 0 ppm Rad = 26 cpm P.P. = 0.5-2.5 kg/cm^2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ5G	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

ELEVATION DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE START 12:30, 4/19/91 FINISH 10:23, 4/24/91 LOGGER C. D. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	N/A Archive	4.6	N/A	SANDY LEAN CLAY (CL), moderate yellowish brown (10 YR 5/2), mottled with light gray (N7), stiff, wet, plastic, some oxidation stains and trace chert gravel		HNu = 0 ppm Rad = 40 cpm P.P. = 1.5-3.0 kg/cm^2
					CLAYEY SAND (SC), moderate yellowish brown (10 YR 5/4), wet, stiff, trace chert gravel		
35	35-40	N/A Archive	5.0	N/A	SANDY LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 3/4) medium gray (N7), trace chert, moist, wet, stiff		HNu = 0 ppm Rad = 52 cpm P.P. = 2.25-3.0 kg/cm^2 stopped drilling 1319 ready to set isolation casing
					CLAYEY SAND (SC), moderate yellowish brown (10 YR 5/4), wet, stiff, trace chert gravel		
					SANDY LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and medium gray (N5), trace chert, stiff to very stiff, some oxidation, wet, slightly plastic		
40	40-45	N/A Archive	4.5	N/A			resumed drilling 0850 4/24/91, Rad bkgd=28 cpm HNu = 0 ppm Rad = 48 cpm P.P. = 2.0->4.5 kg/cm^2 approximately 3' of mud slop, 2' of true recovery due to downhole water
					SANDY LEAN CLAY (CL), light brown (5 YR 5/6), moist, very stiff to hard, slightly plastic		
45	45-50	N/A Archive	5.0	N/A			HNu = 0 ppm Rad = 30 cpm P.P. = 4.0->4.5 kg/cm^2
					SANDY LEAN CLAY (CL), same as above except with sparse, well graded sand clusters ? — ?		
50	50-55	N/A Archive	0.0	N/A	? Chert gravel ?		Hnu = no sample Rad = recovery P.P. = Sampler had approximately 2.5" dia. subangular chert stone stuck in bottom end cap-no recovery
55	55-60	N/A Archive	2.5	N/A	? — ?		HNu = 0 ppm Rad = 39 cpm P.P. =
					POORLY GRADED SAND W/ GRAVEL (SP-SC), mottled moderate brown (5 YR 4/4) with sparce light gray (N7) sand, wet		
					WELL GRADED GRAVEL W/ SAND (GW), moderate brown (5 YR 4/4), subangular chert gravel, wet		
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
NJO30888.BA	PZ5G	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION C535-C537

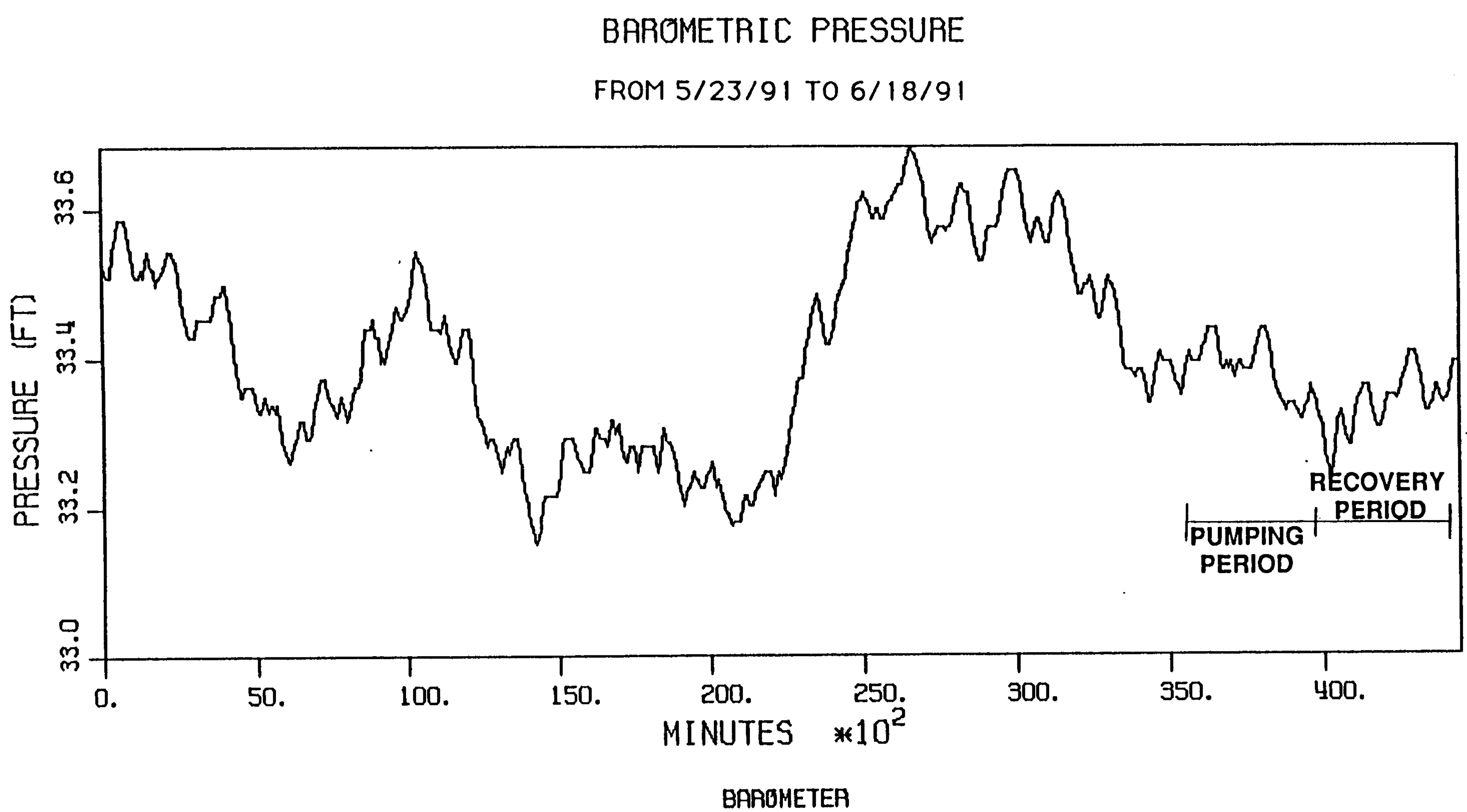
ELEVATION ______ DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD Hollow Stem Auger; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE approx. 30', approx. 57' aquifer START 12:30, 4/19/91 FINISH 10:23, 4/24/91 LOGGER C. D. Webb

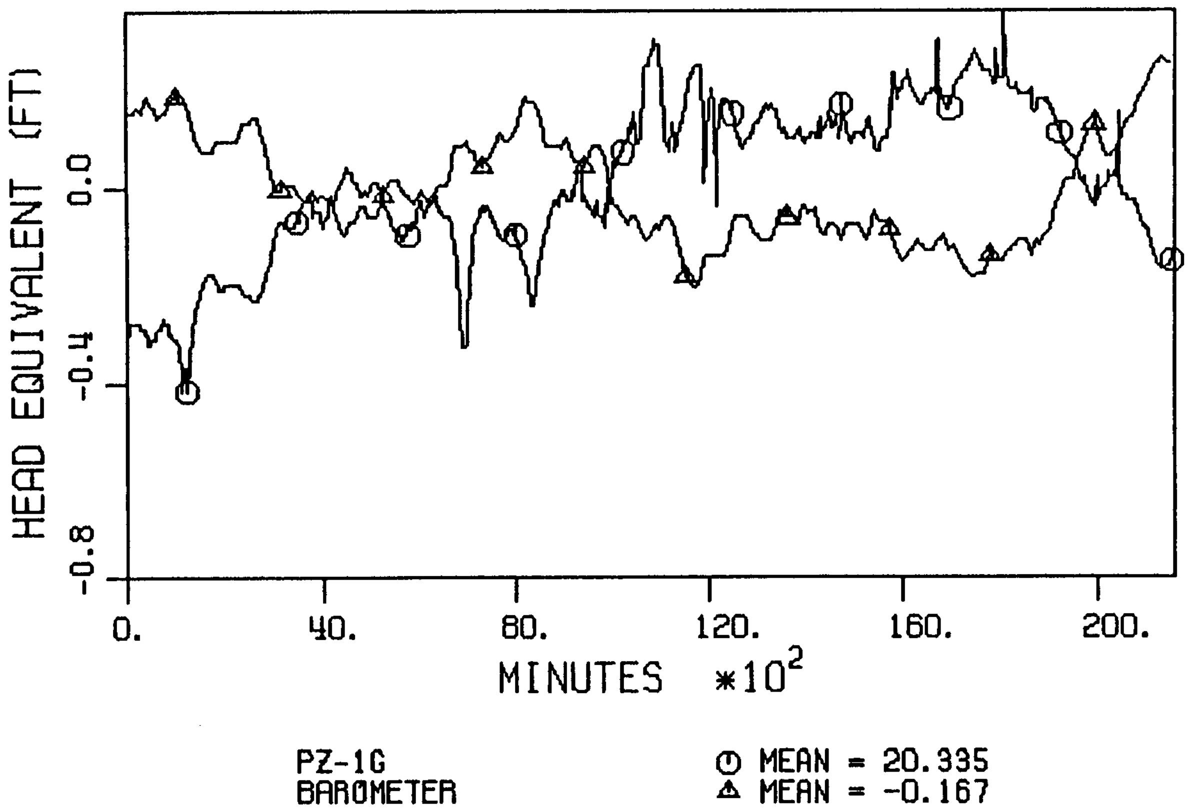
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	N/A Archive	2.0	N/A	WELL GRADED GRAVEL W/SAND (GW), modertate brown (5 YR 4/4), subangular chert gravel, wet		HNu = 0 ppm Rad = 30 cpm P.P. = stopped drilling to bail formation water
65	65-70	N/A Archive	2.0	N/A	WELL GRADED GRAVEL W/SAND (GW), same as above, except with some subrounded chert		HNu = 0 ppm Rad = 28 cpm P.P. =
70					End of Boring		Total depth- hole sanding in: visible on hex rods. Got approximately 1.5' on bottom

Attachment B
BACKGROUND WATER LEVELS AND BAROMETRIC PLOTS


BARØMETRIC PRESSURE
FROM 5/23/91 TO 6/18/91
PRESSURE (FT)
33.0
33.2
33.4
33.6
0.
50.
100.
150.
200.
250.
300.
350.
400.
MINUTES *10^2
PUMPING PERIOD
RECOVERY PERIOD
BARØMETER

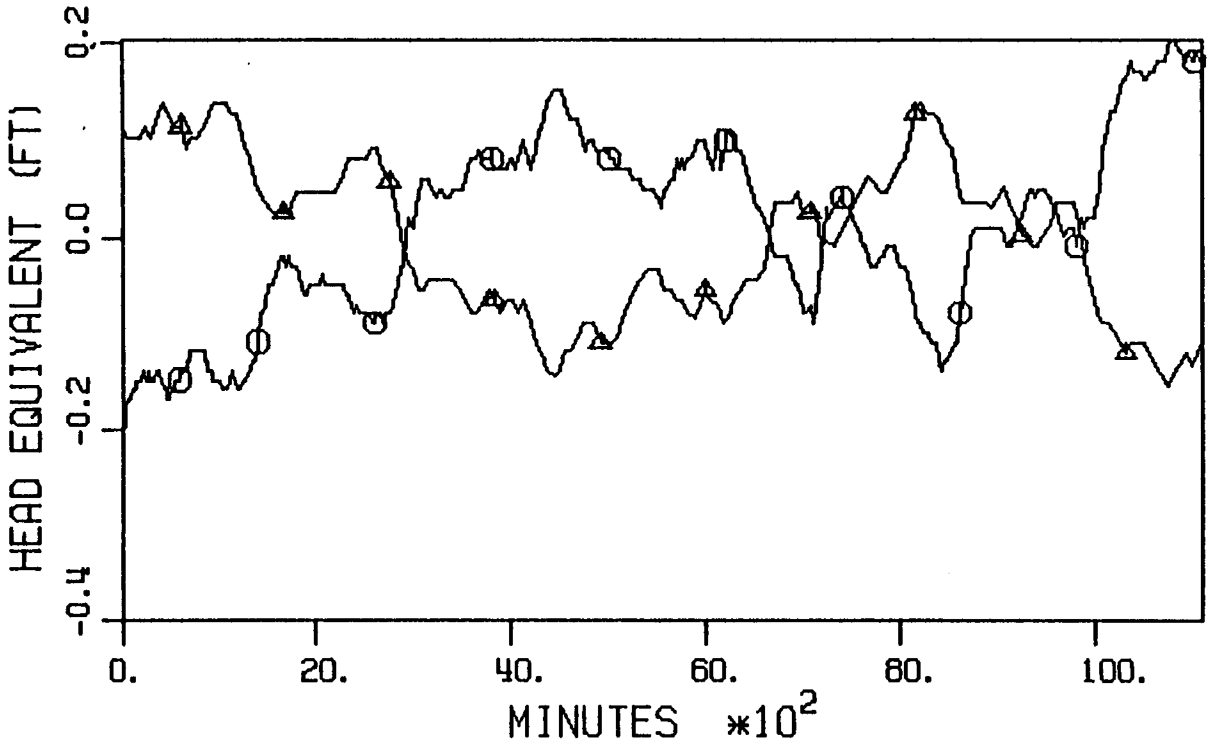
BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)



BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-5/30/91)

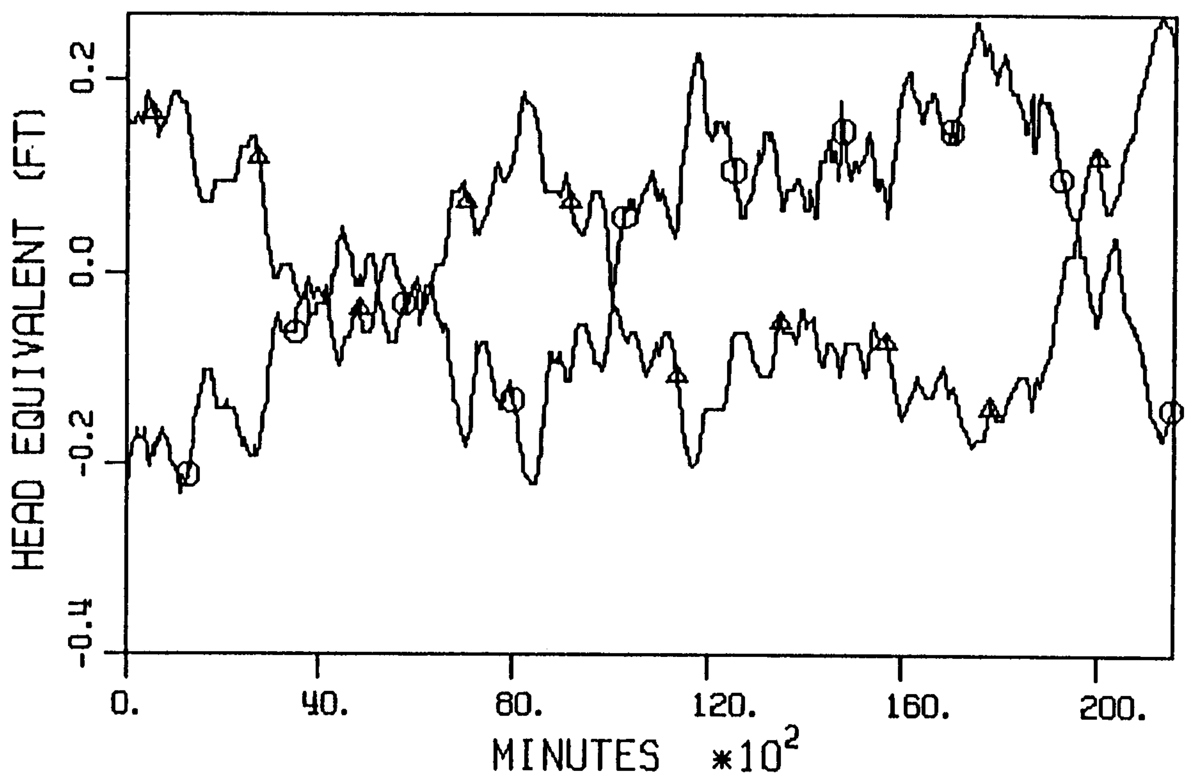


PZ-2G ⊕ MEAN = 20.867

BAROMETER △ MEAN = -0.117

BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

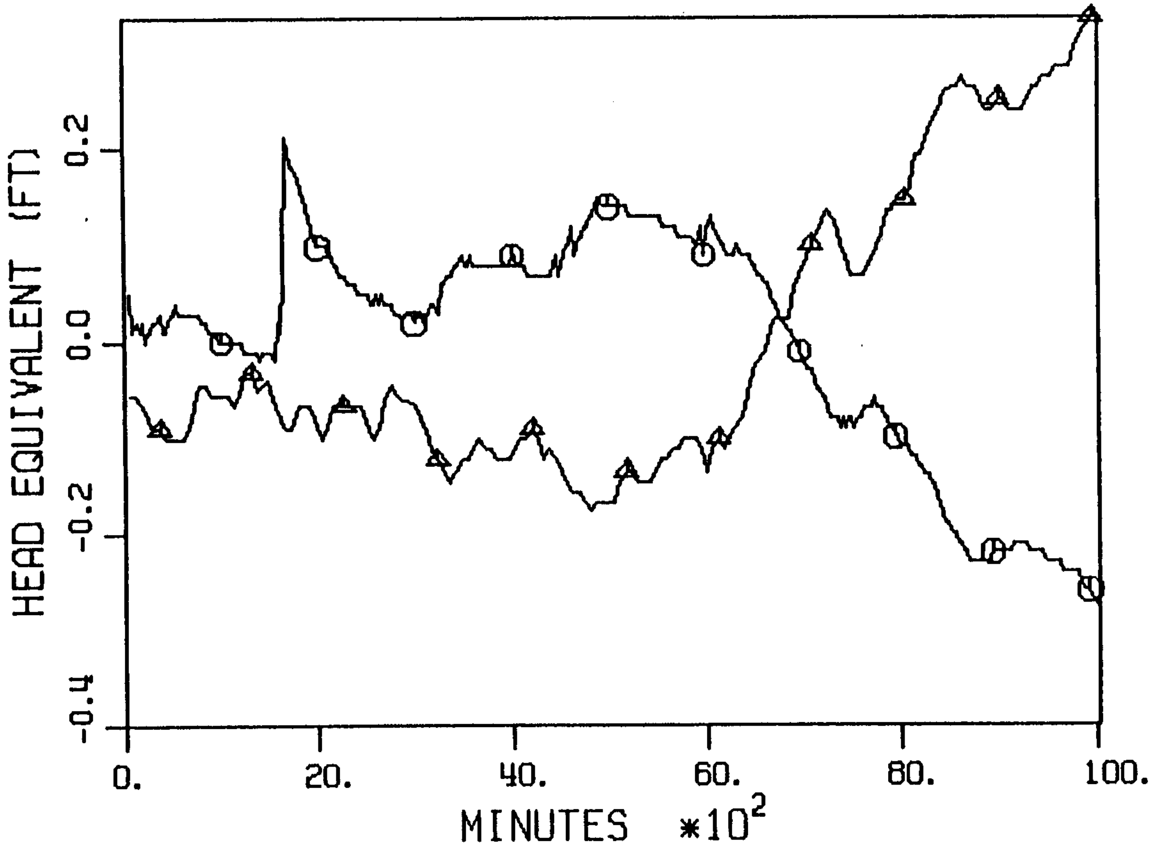
EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)



PZ-3G
BAROMETER

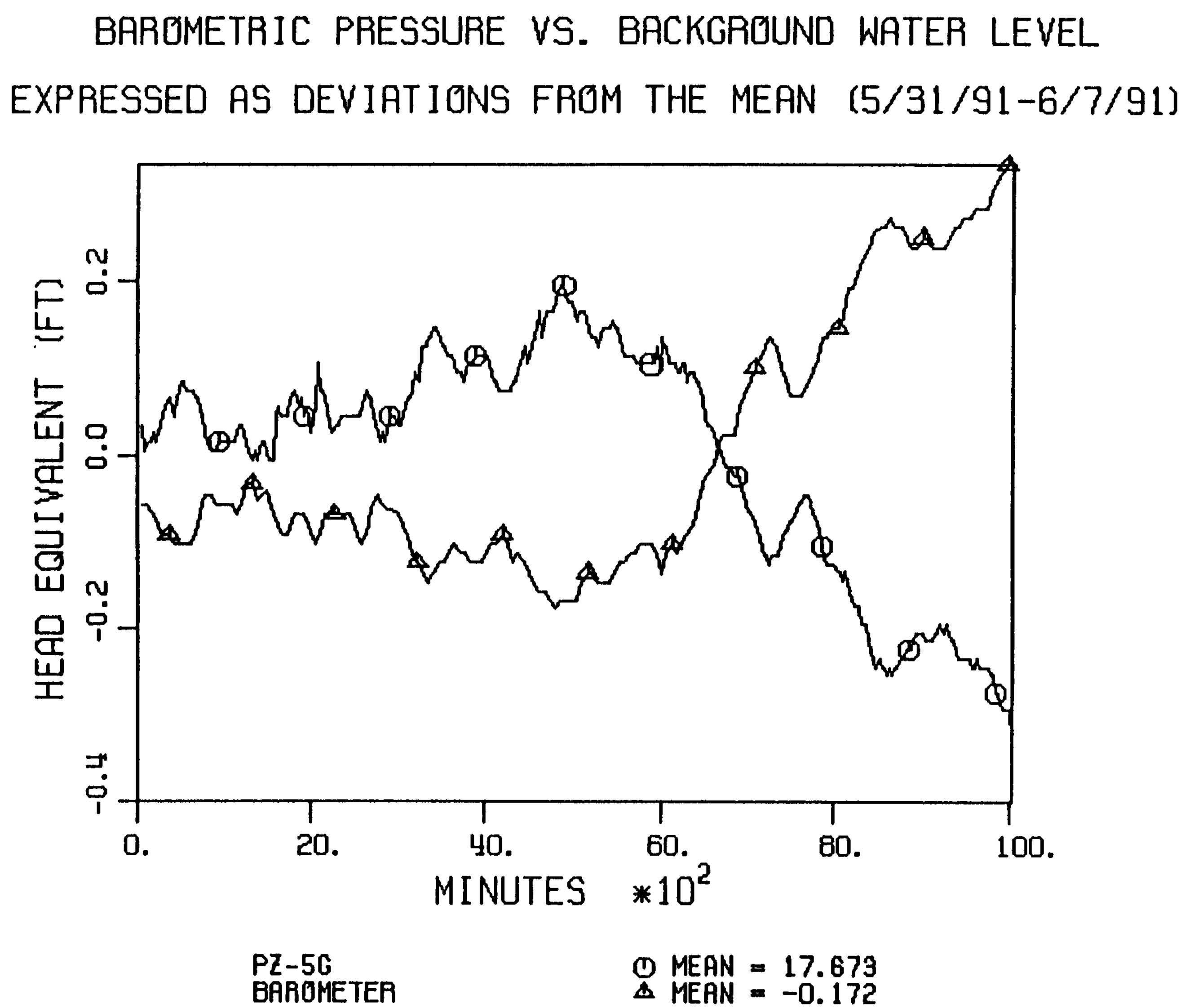
O MEAN = 20.531
Δ MEAN = -0.166

BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL
EXPRESSED AS DEVIATIONS FROM THE MEAN (5/31/91-6/7/91)

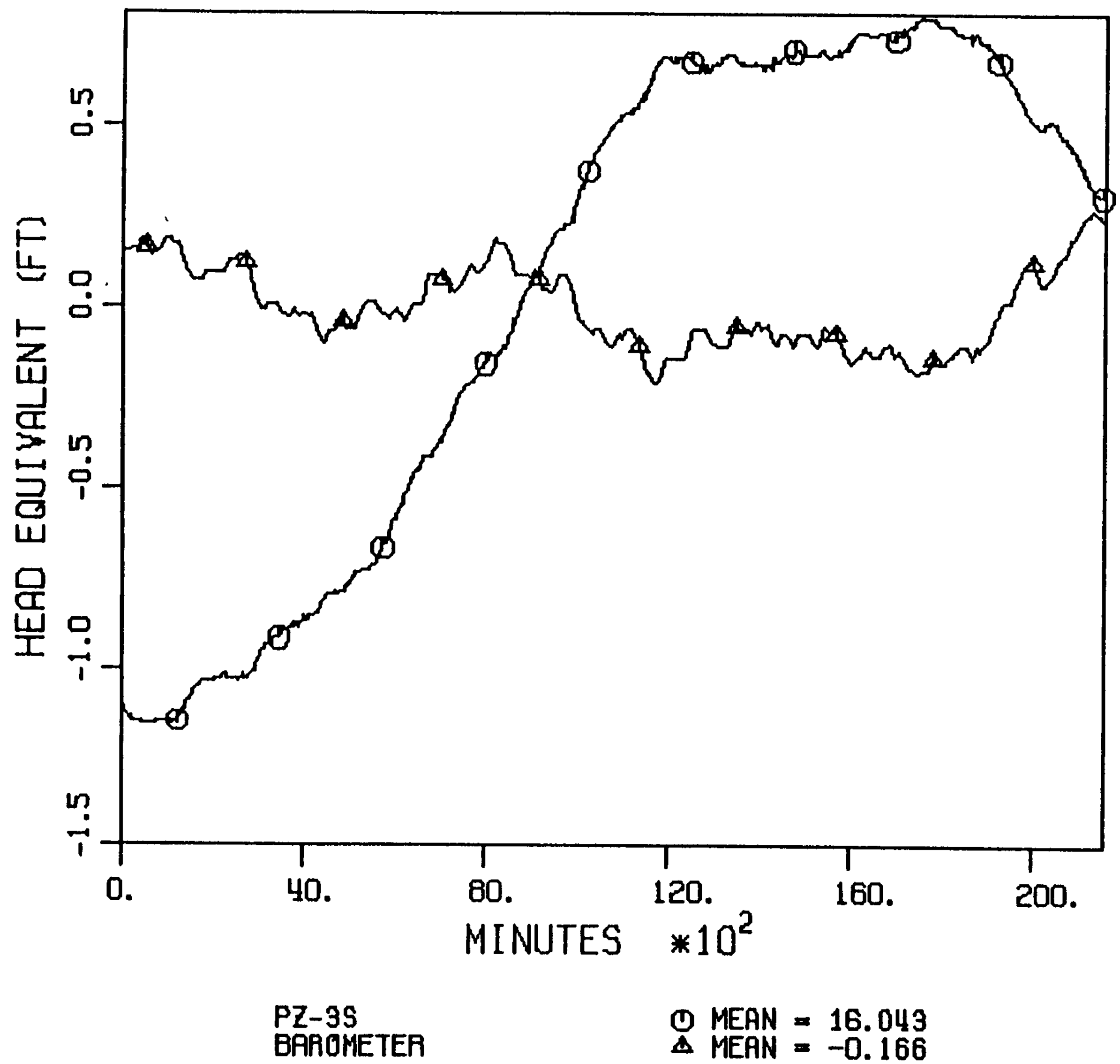


PZ-4G
BAROMETER

○ MEAN = 15.919
△ MEAN = -0.172

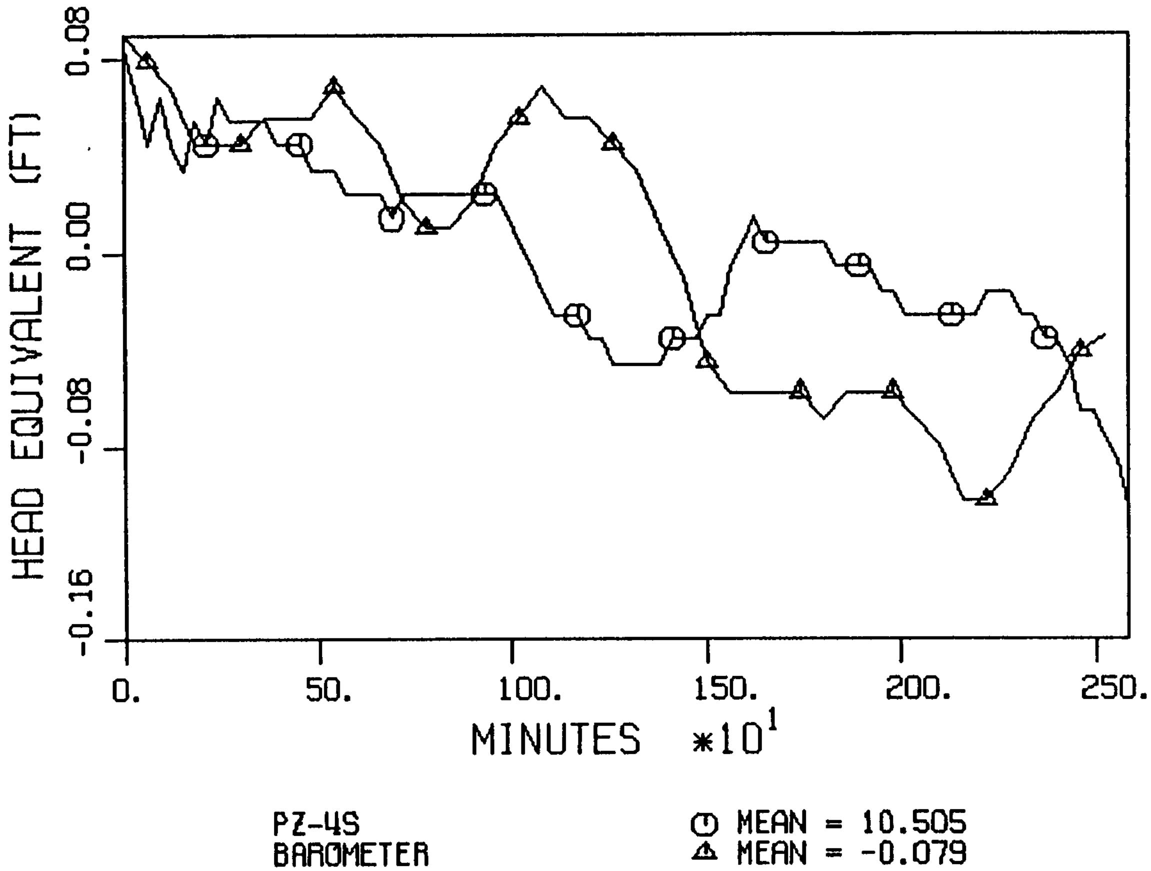

BARØMETRIC PRESSURE VS. BACKGRØUND WATER LEVEL
EXPRESSED AS DEVIATIØNS FRØM THE MEAN (5/31/91-6/7/91)
HEAD EQUIVALENT (FT)
0.2
0.0
-0.2
-0.4
0.
20.
40.
60.
80.
100.
MINUTES *10^2
PZ-5G
BARØMETER
MEAN = 17.673
MEAN = -0.172

BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL
EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)



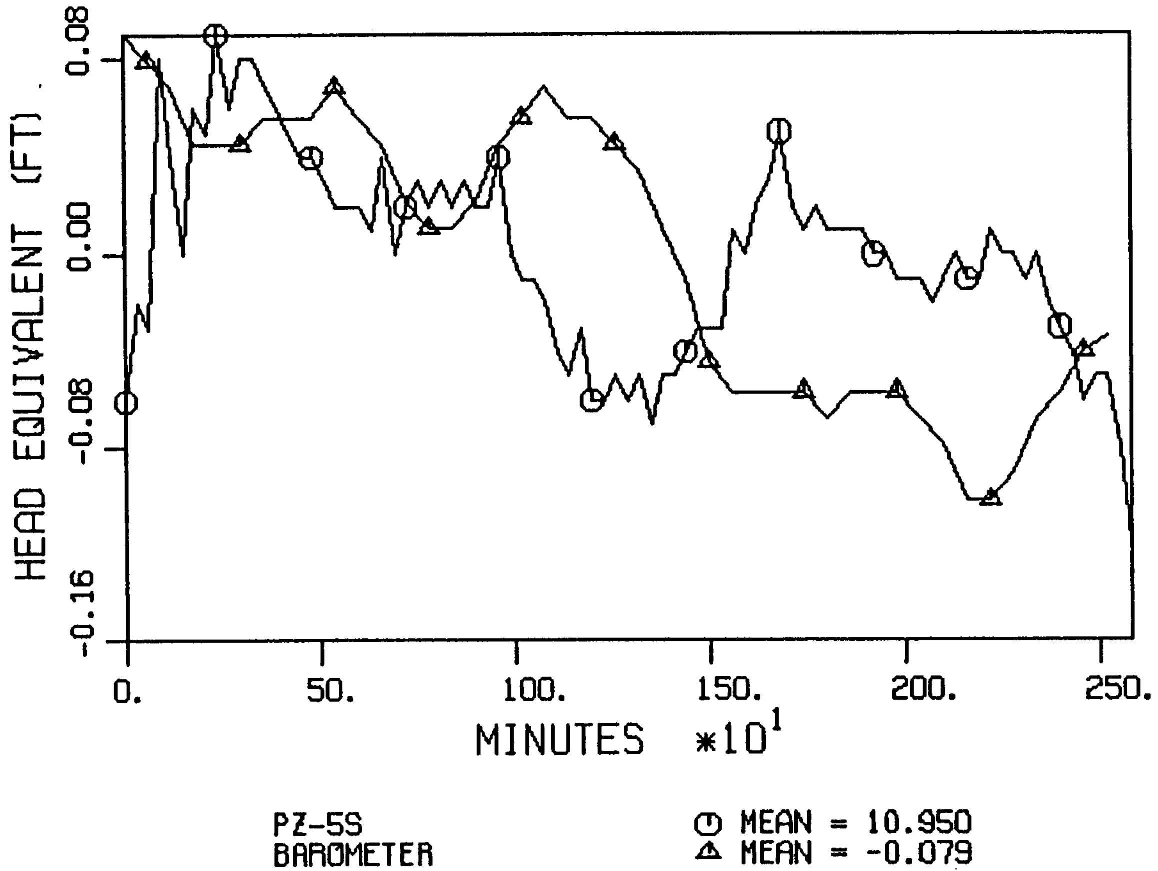
BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

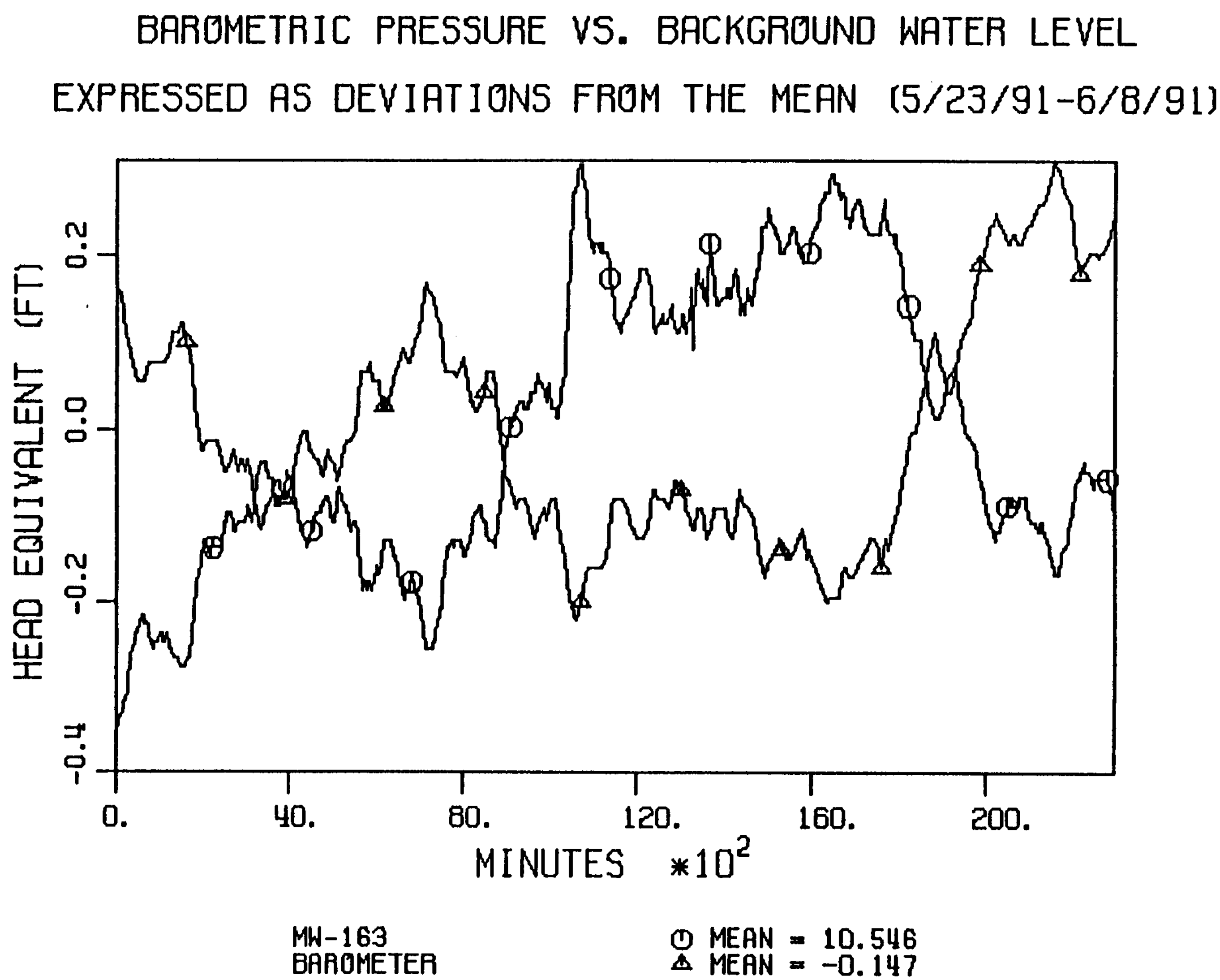
EXPRESSED AS DEVIATIONS FROM THE MEAN (6/10/91-6/12/91)



BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (6/10/91-6/12/91)

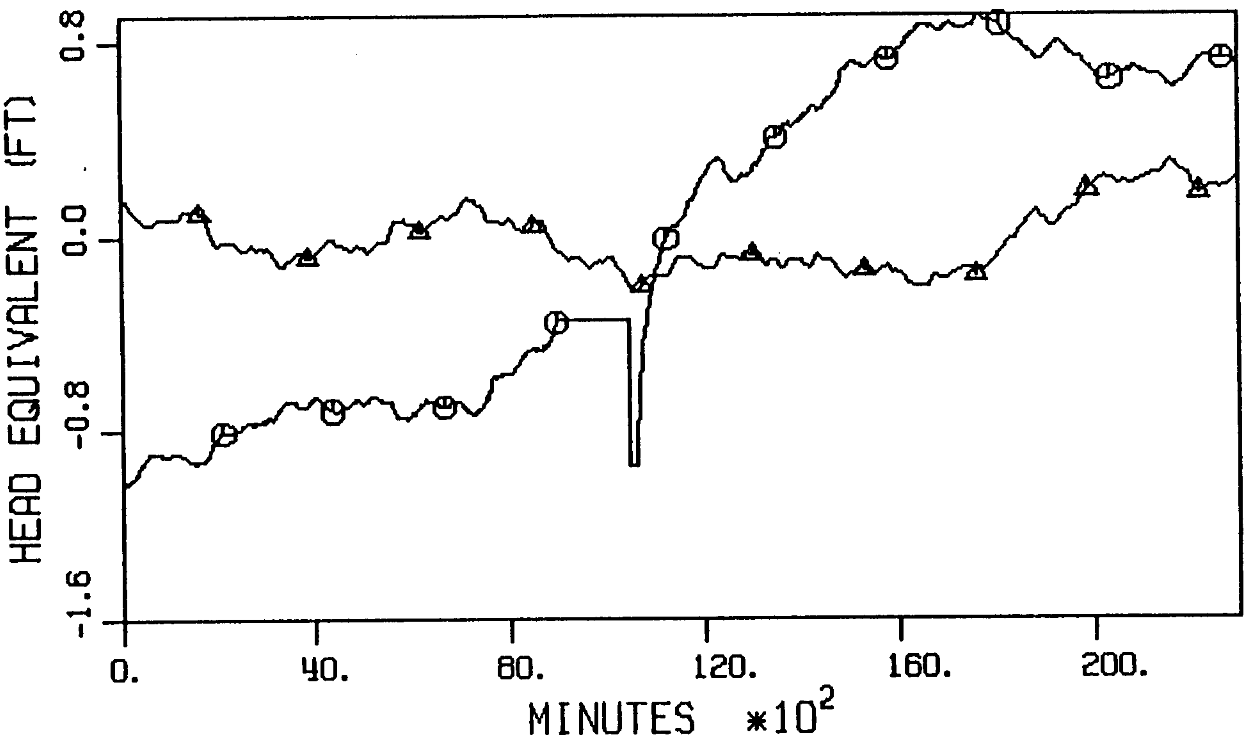




BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL
EXPRESSED AS DEVIATIONS FROM THE MEAN (5/23/91-6/8/91)
HEAD EQUIVALENT (FT)
0.2
0.0
-0.2
-0.4
0.
40.
80.
120.
160.
200.
MINUTES *10^2
MW-163
BAROMETER
MEAN = 10.546
MEAN = -0.147

BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (5/23/91-6/8/91)

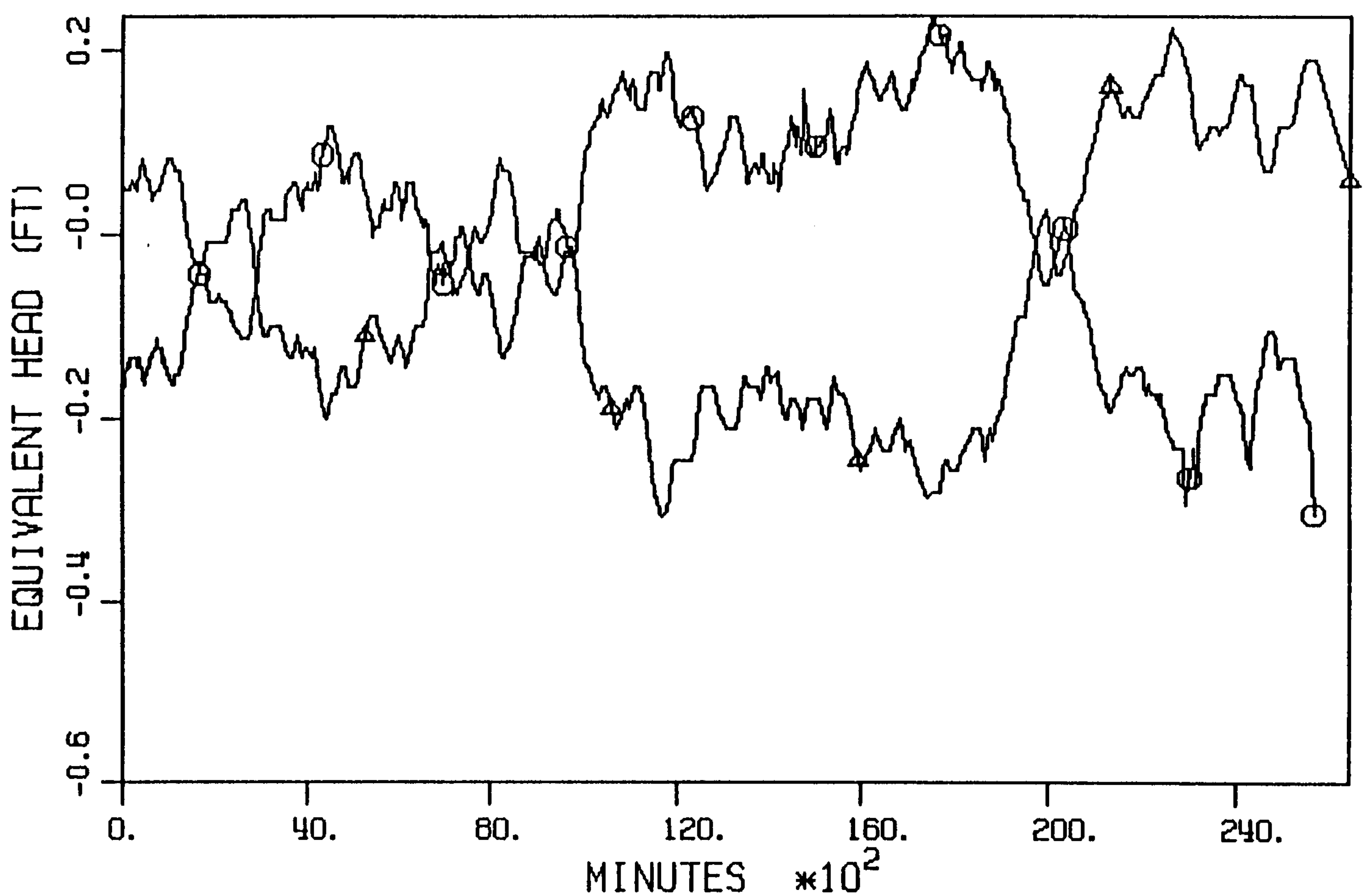


MW-164 ⦶ MEAN = 5.952

BAROMETER △ MEAN = -0.147

BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)

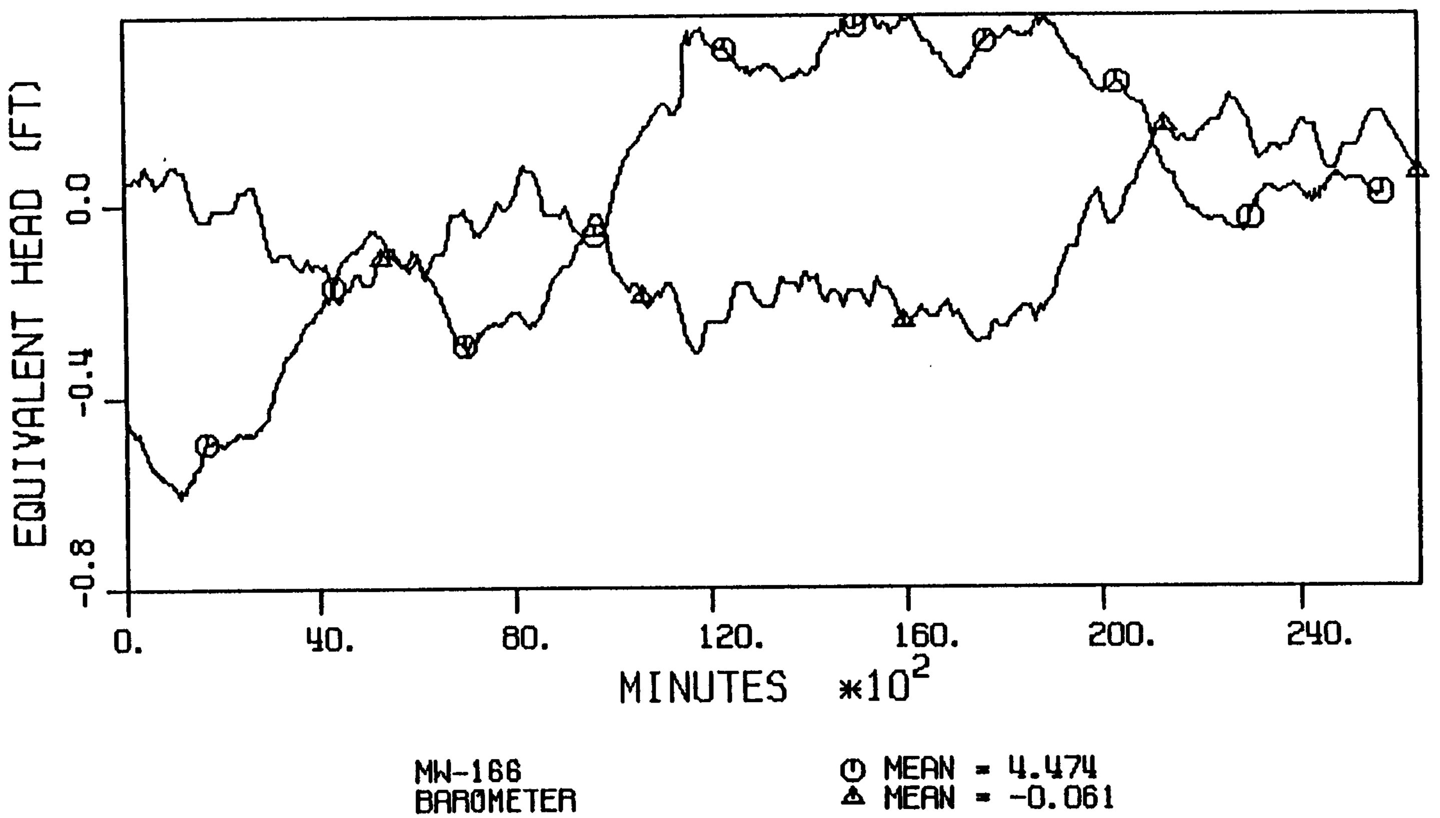


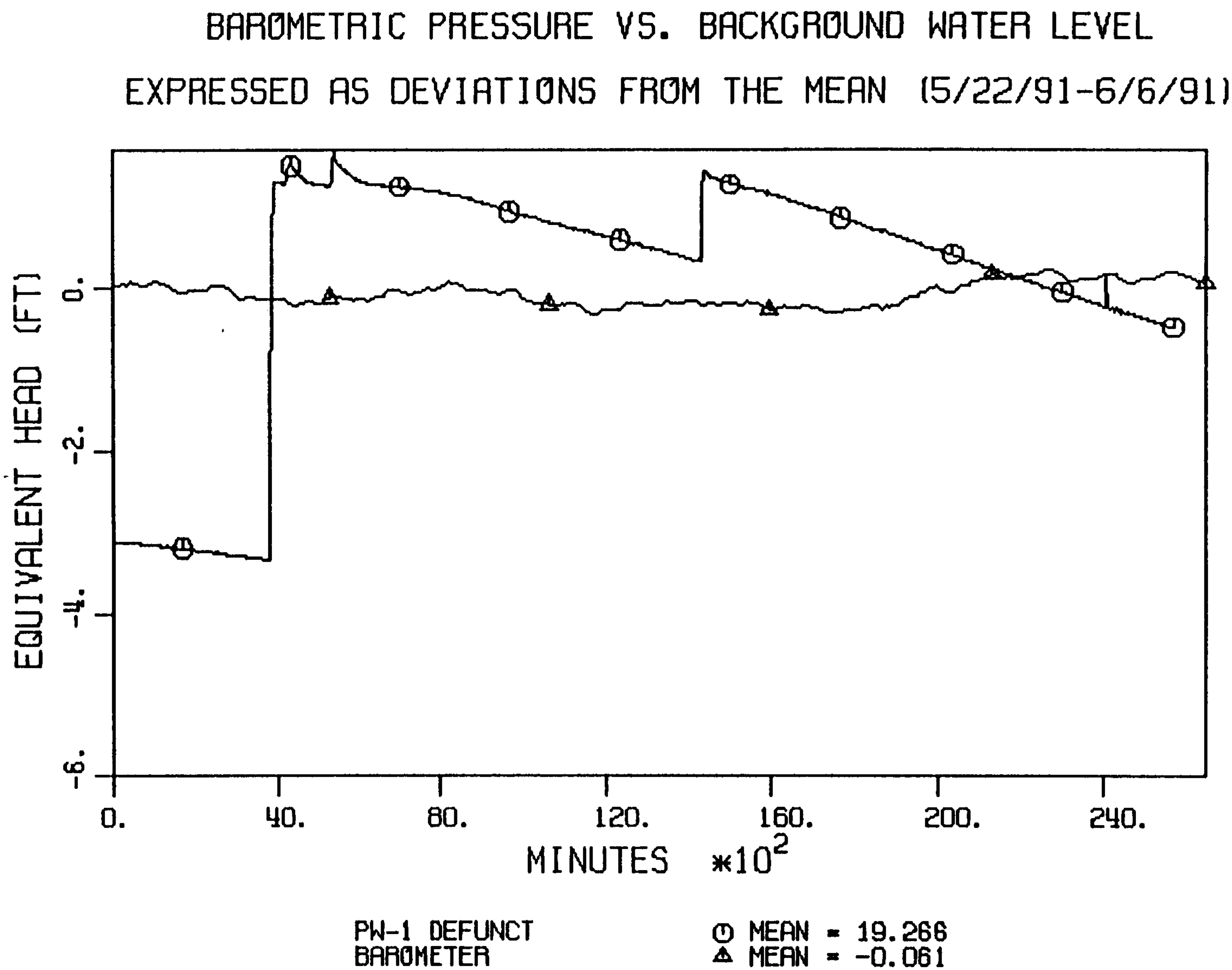
MW-165 — ⊙ MEAN = 12.542

BAROMETER — △ MEAN = -0.061

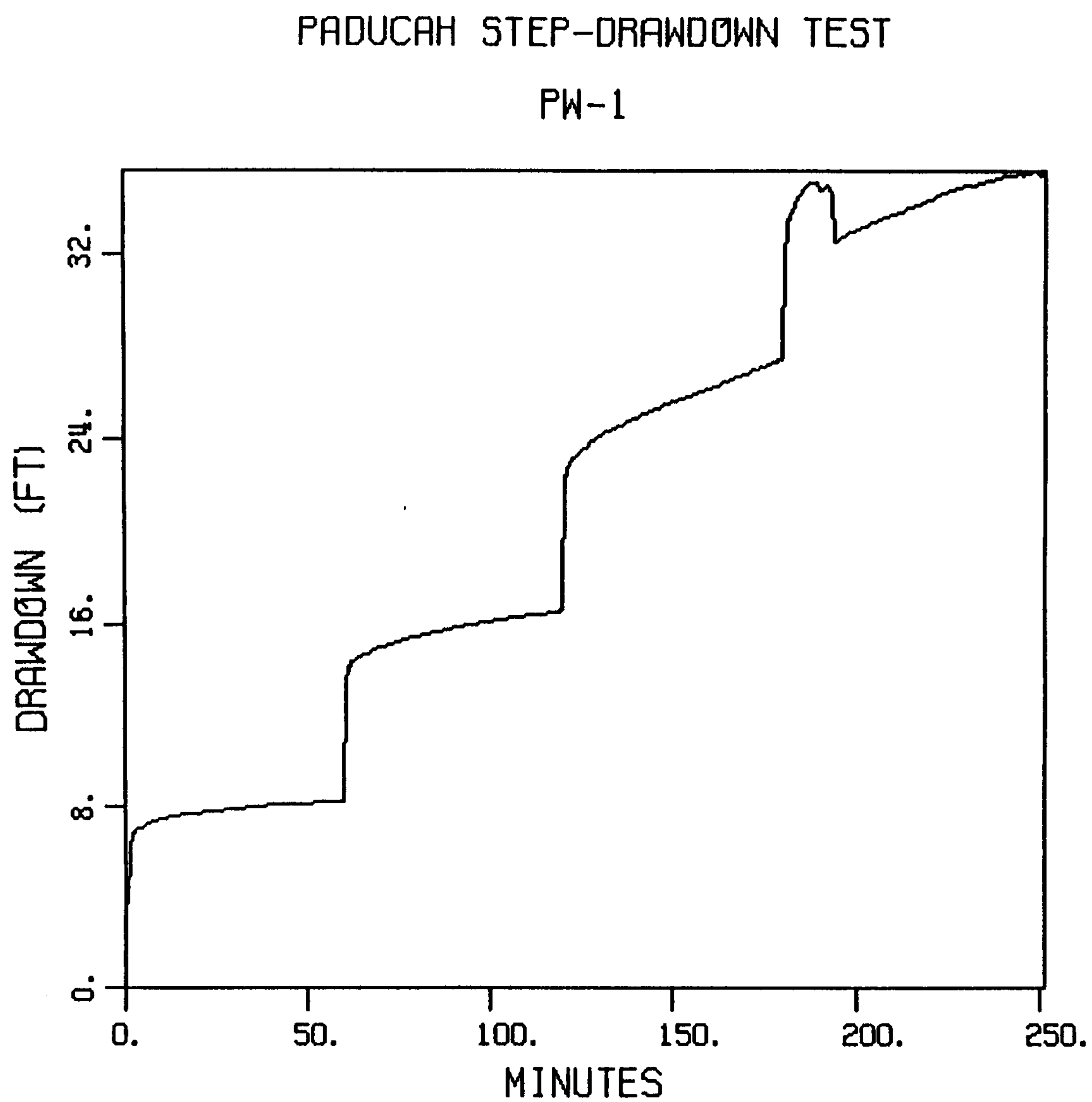
BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL

EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)




BAROMETRIC PRESSURE VS. BACKGROUND WATER LEVEL
EXPRESSED AS DEVIATIONS FROM THE MEAN (5/22/91-6/6/91)
EQUIVALENT HEAD (FT)
0.
-2.
-4.
-6.
0.
40.
80.
120.
160.
200.
240.
MINUTES *10^2
PW-1 DEFUNCT
BAROMETER
MEAN = 19.266
MEAN = -0.061

Attachment C
STEP-DRAWDOWN CURVES



PW-1

Figure C-1

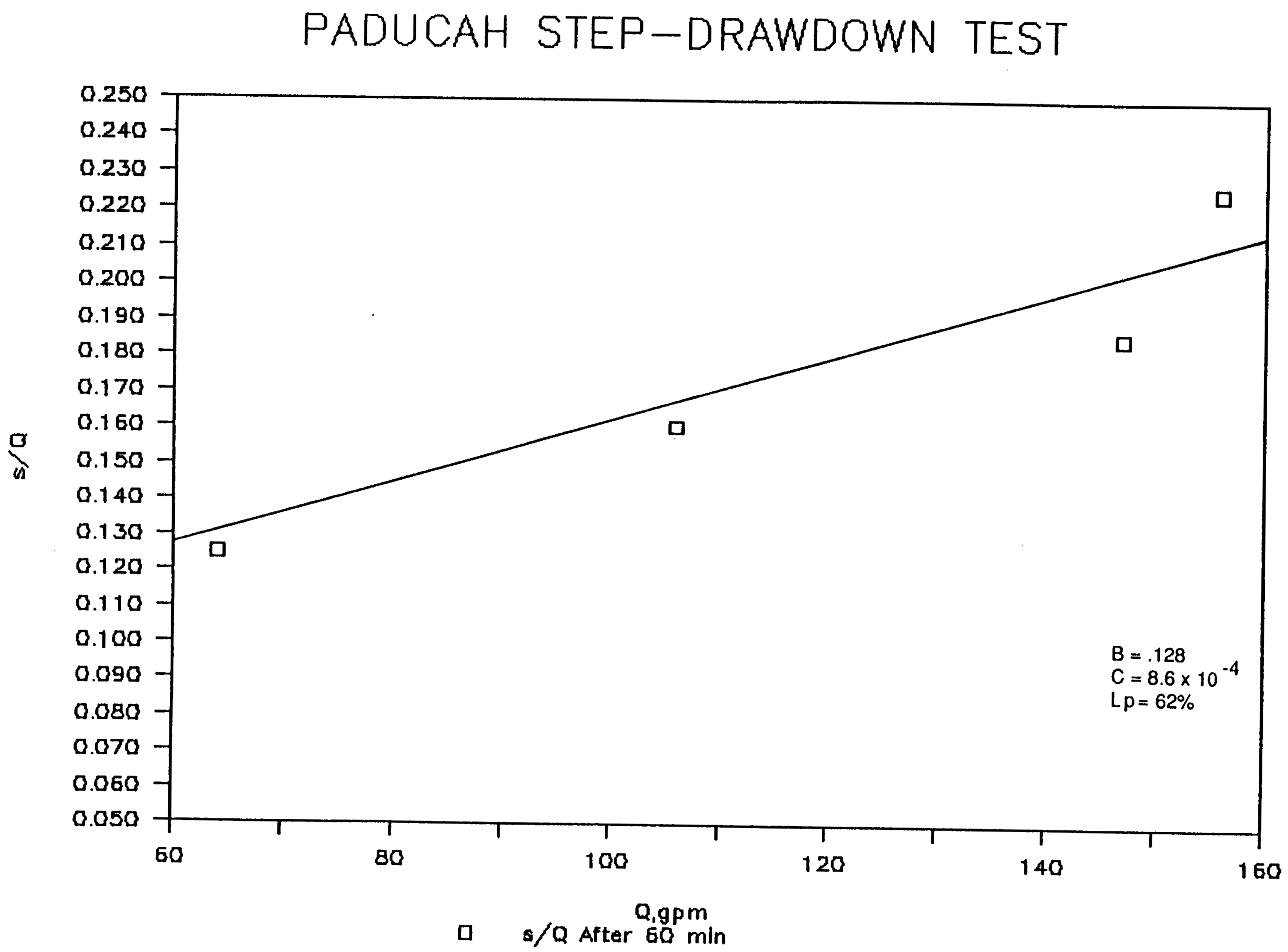

PADUCAH STEP-DRAWDOWN TEST
0.250
0.240
0.230
0.220
0.210
0.200
0.190
0.180
0.170
0.160
0.150
0.140
0.130
0.120
0.110
0.100
0.090
0.080
0.070
0.060
0.050
s/Q
60
80
100
120
140
160
Q,gpm
s/Q After 60 min
B = .128
C = 8.6 x 10 -4
Lp = 62%

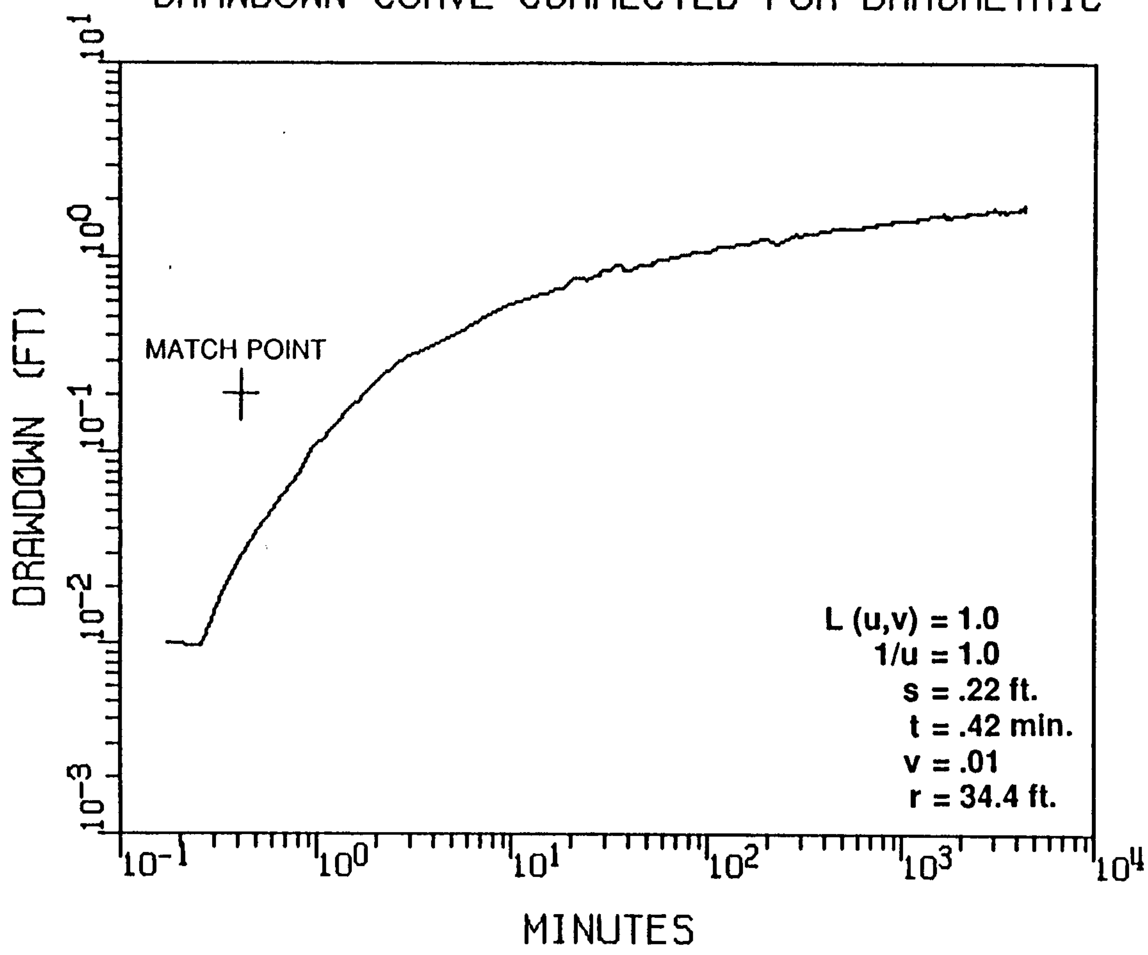
Figure C-2

Attachment D

LOG-LOG DRAWDOWN CURVES

PADUCAH PUMPING TEST

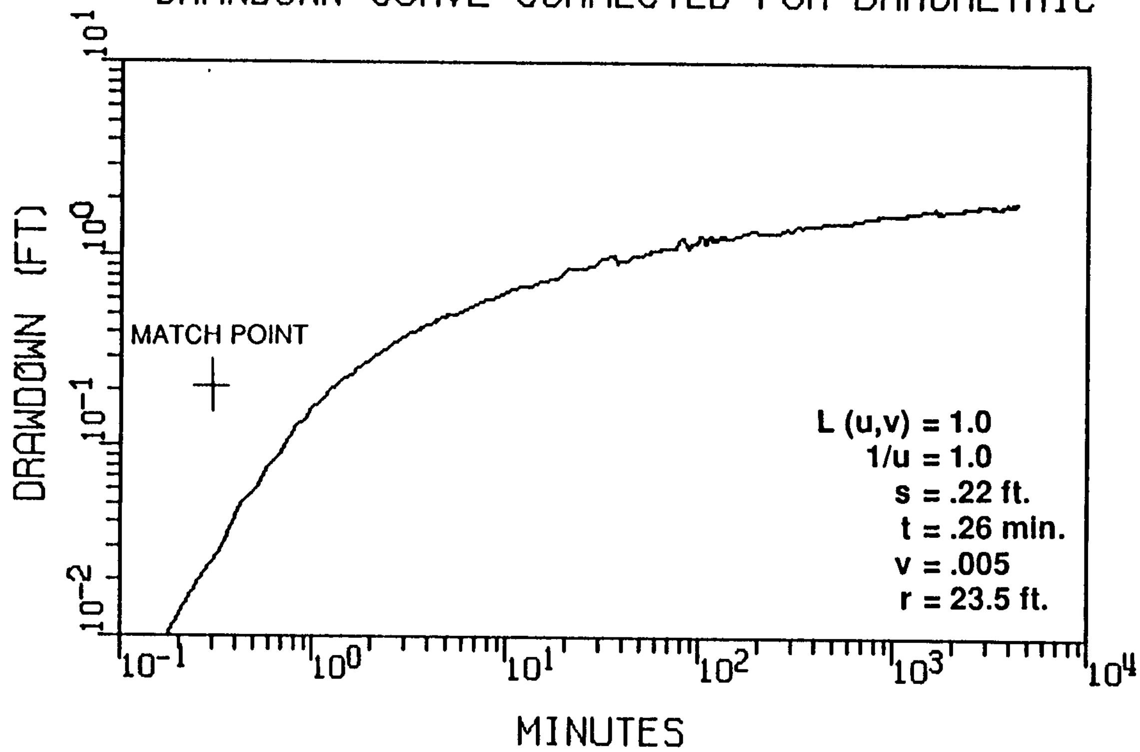
DRAWDOWN CURVE CORRECTED FOR BAROMETRIC



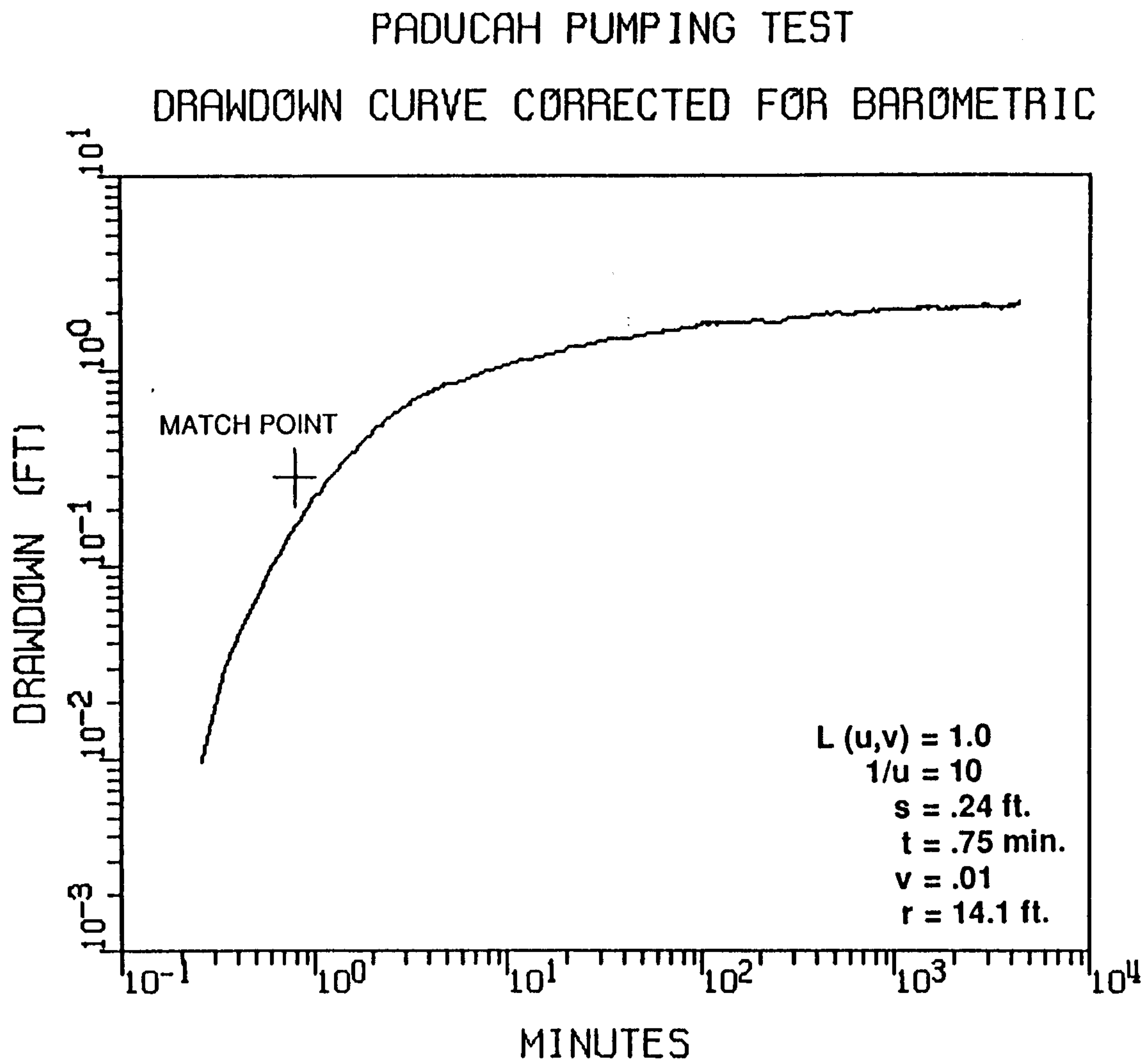
PZ-1G CORRECTED

PADUCAH PUMPING TEST

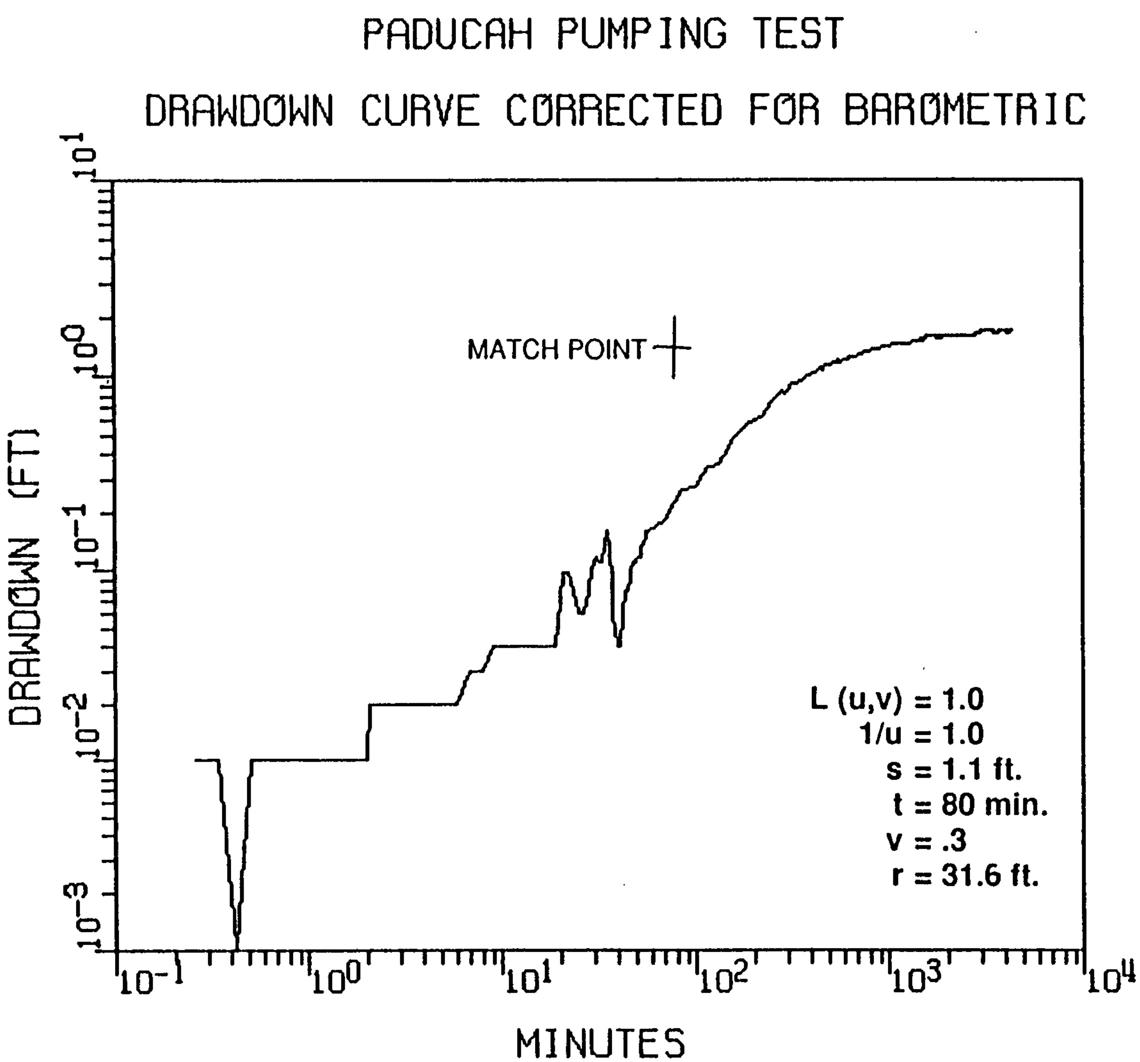
DRAWDOWN CURVE CORRECTED FOR BAROMETRIC



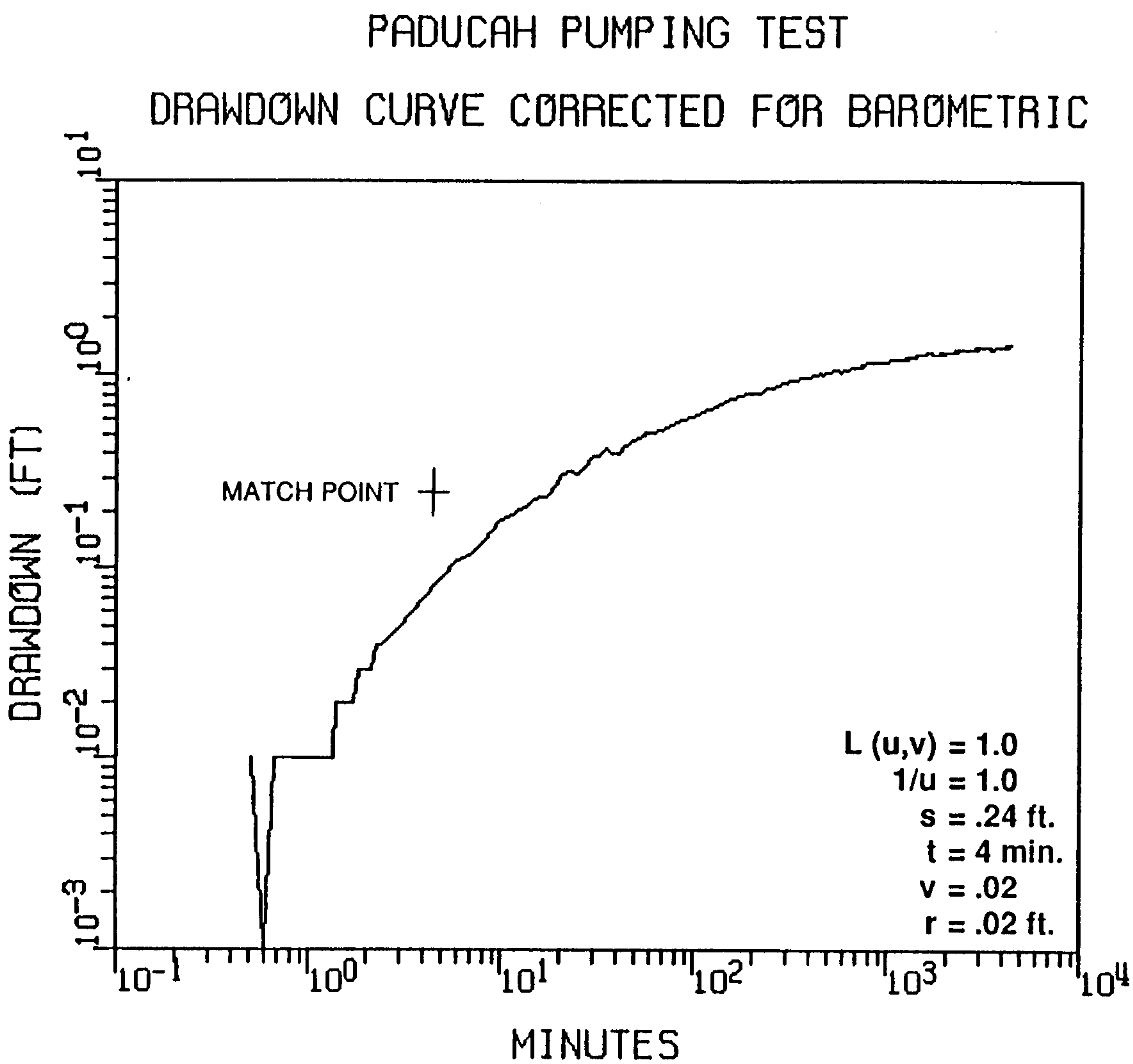
PZ-2G CORRECTED



PZ-3G CORRECTED



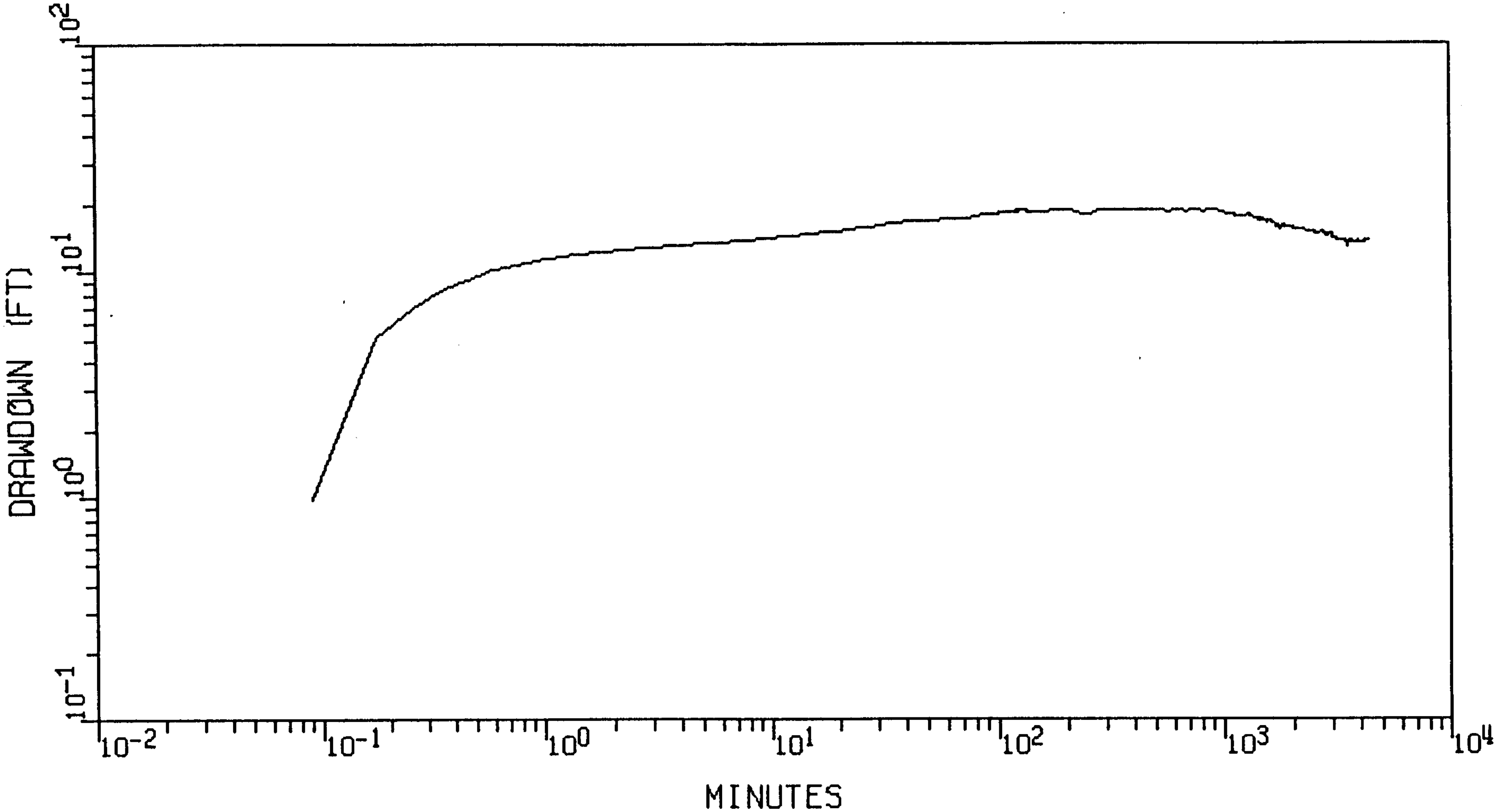
PZ-4G CORRECTED



PZ-5G CORRECTED

PADUCAH PUMPING TEST

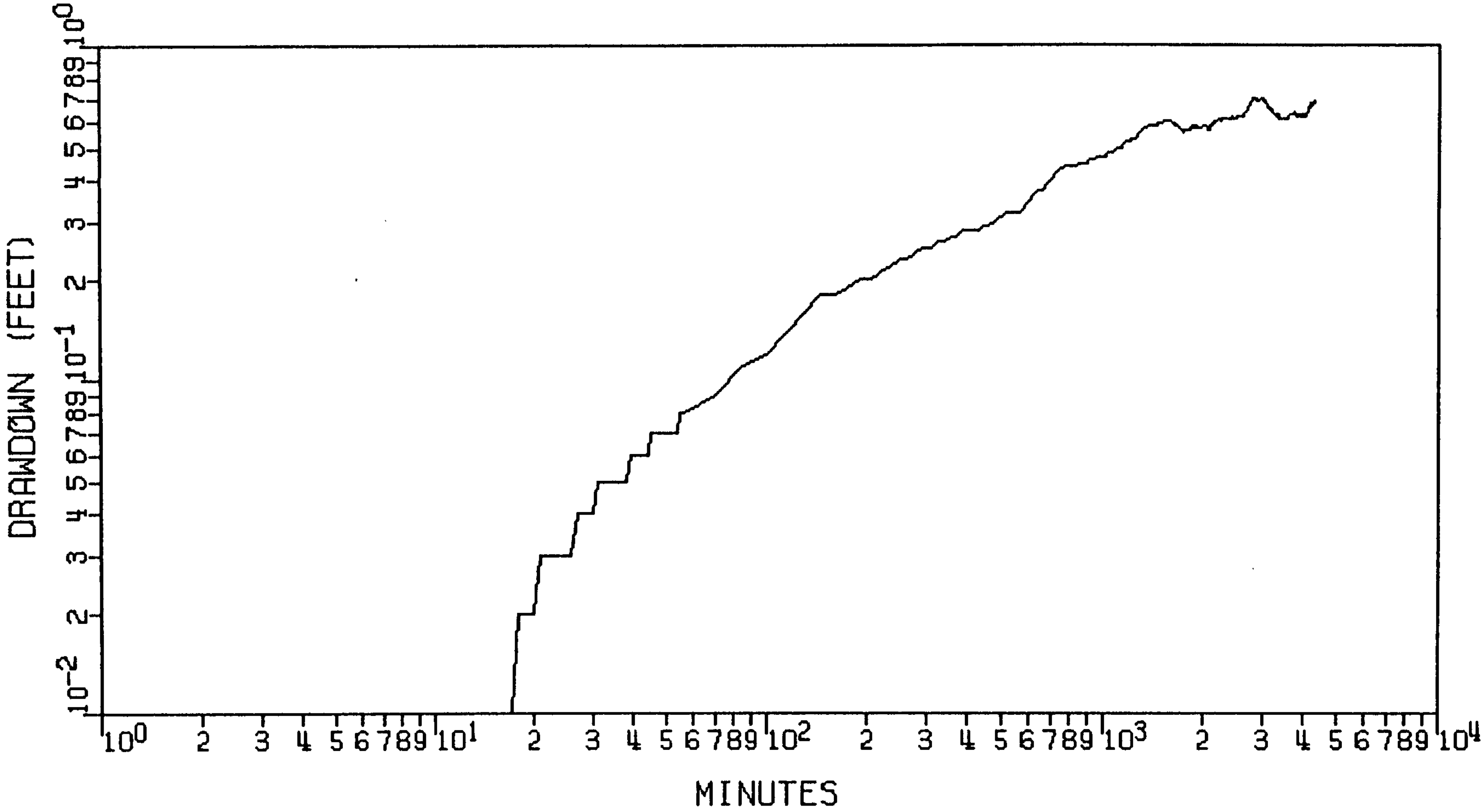
DRAWDOWN CURVE



PW-1

PADUCAH PUMPING TEST

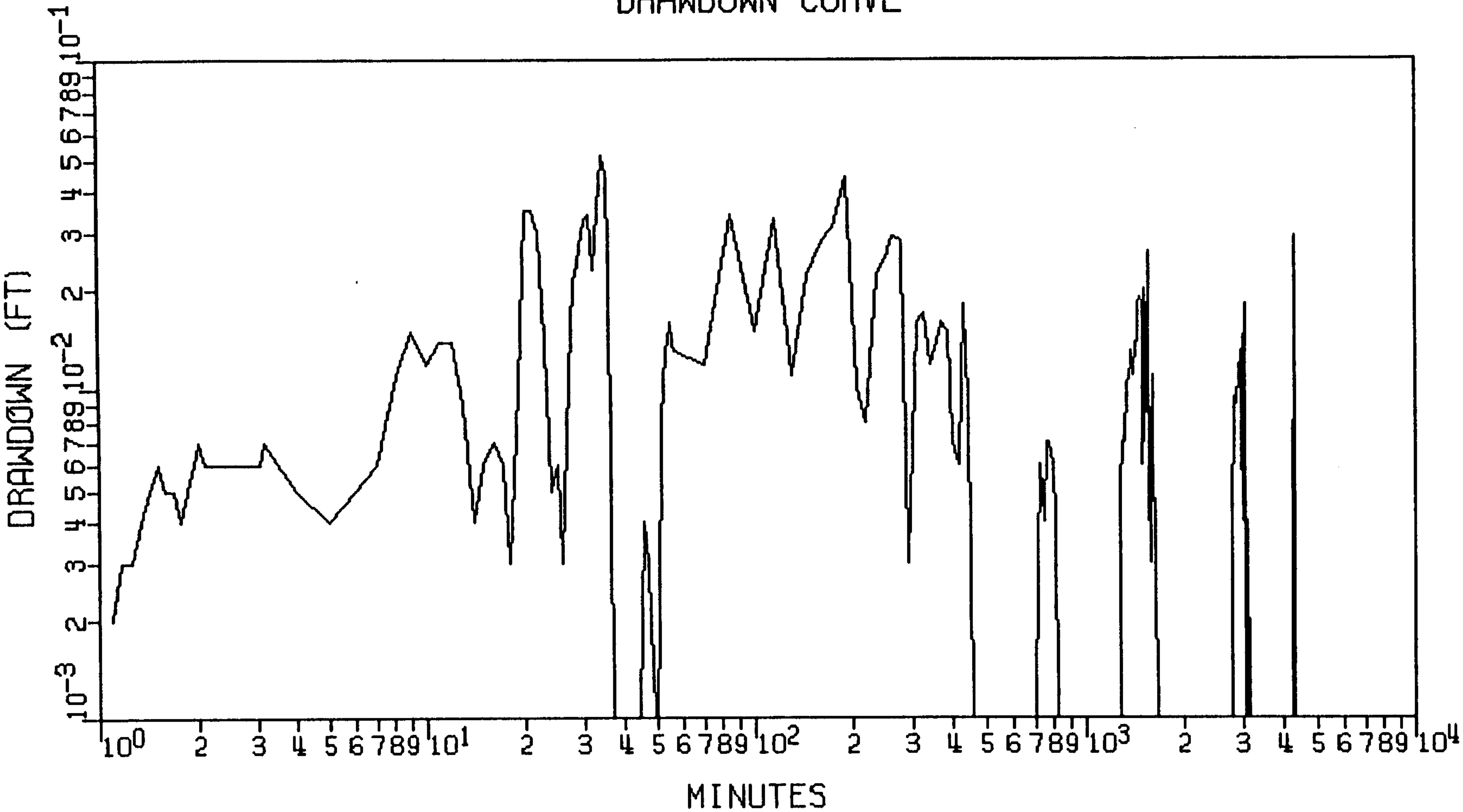
DRAWDOWN CURVE



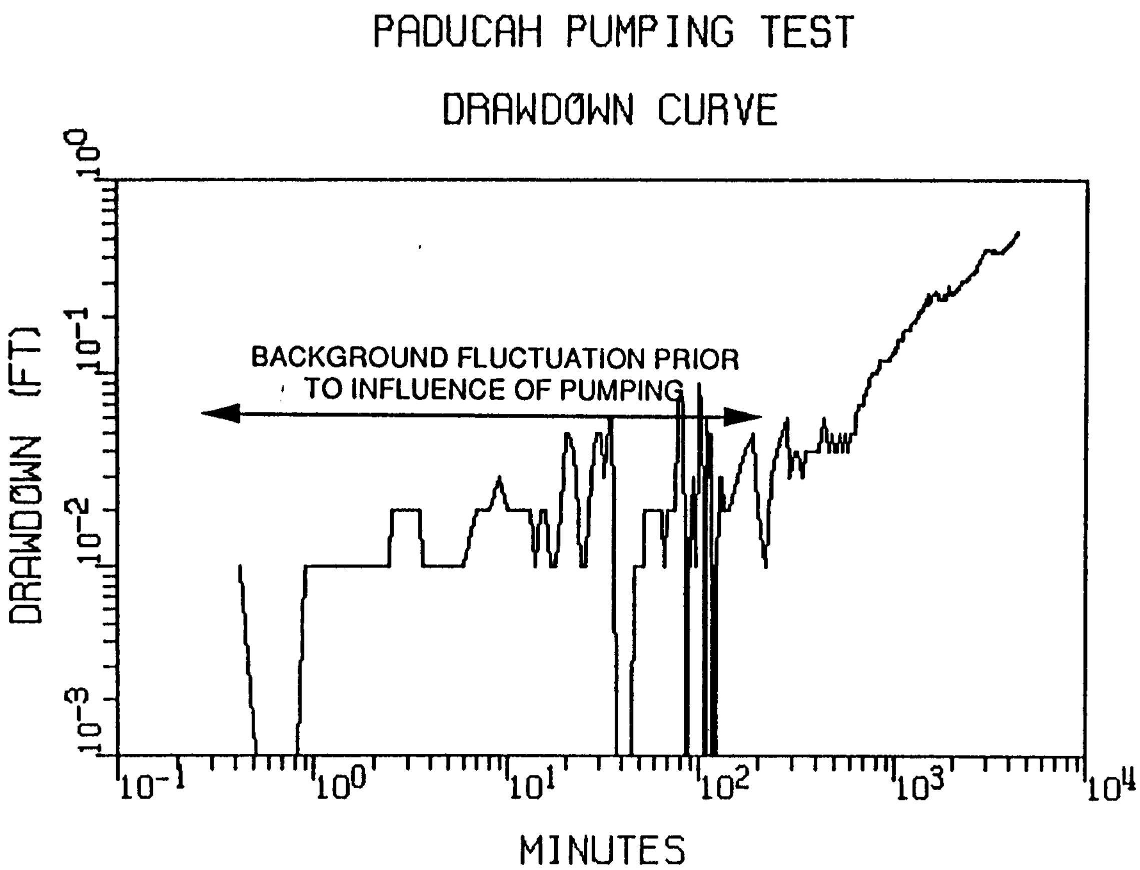
MW-165

PADUCAH PUMPING TEST

DRAWDOWN CURVE



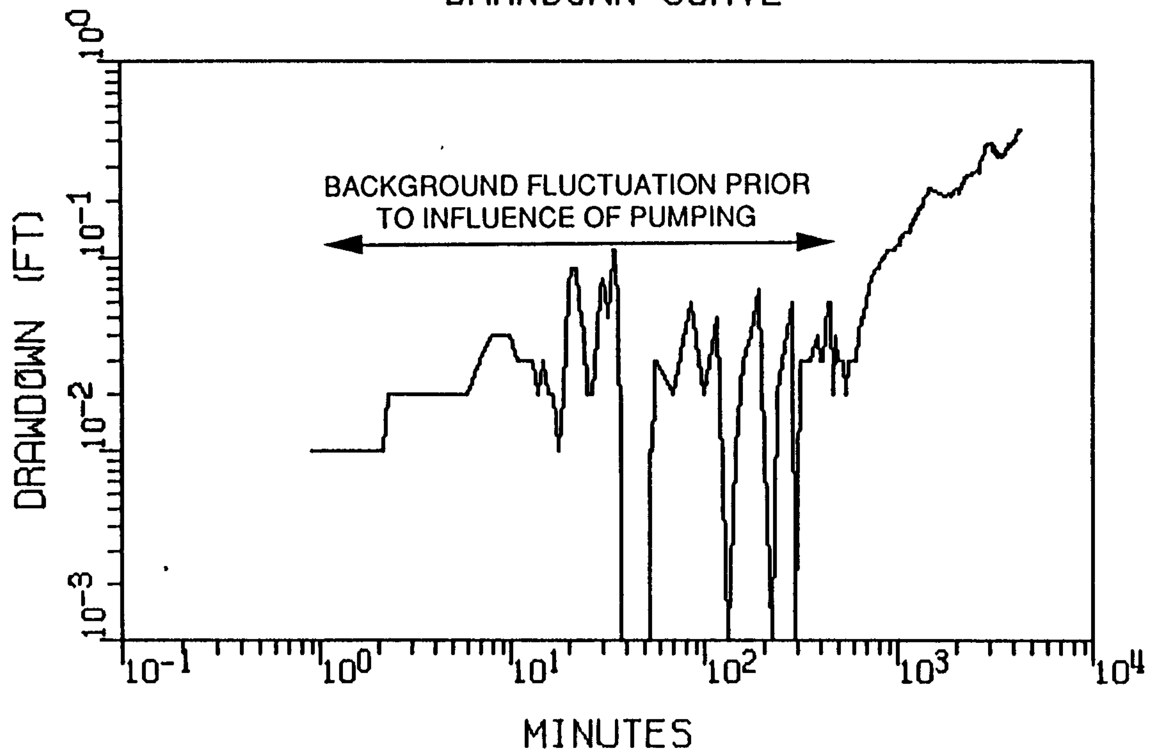
MW-166


PADUCAH PUMPING TEST
DRAWDOWN CURVE
DRAWDOWN (FT)
10^{0}
10^{-1}
10^{-2}
10^{-3}
BACKGROUND FLUCTUATION PRIOR
TO INFLUENCE OF PUMPING
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
MINUTES

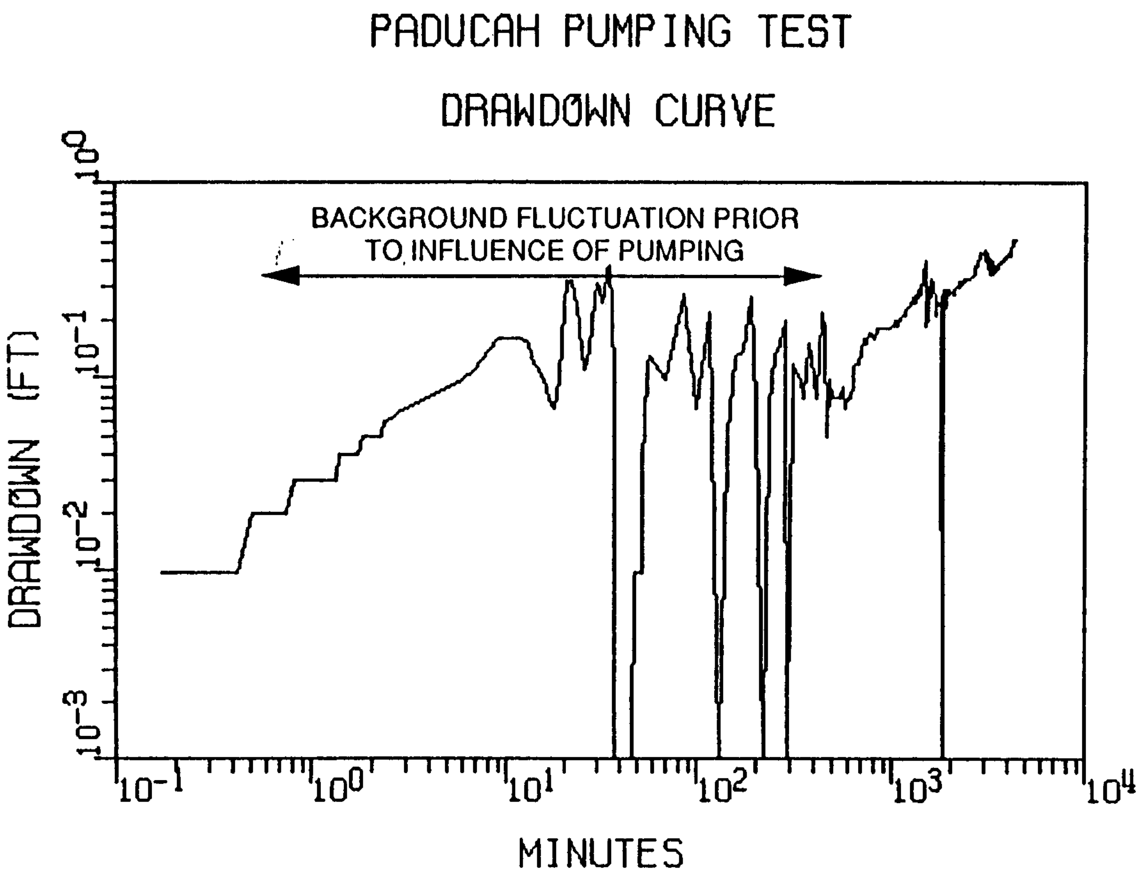
PZ-3S

PADUCAH PUMPING TEST

DRAWDOWN CURVE



PZ-4S

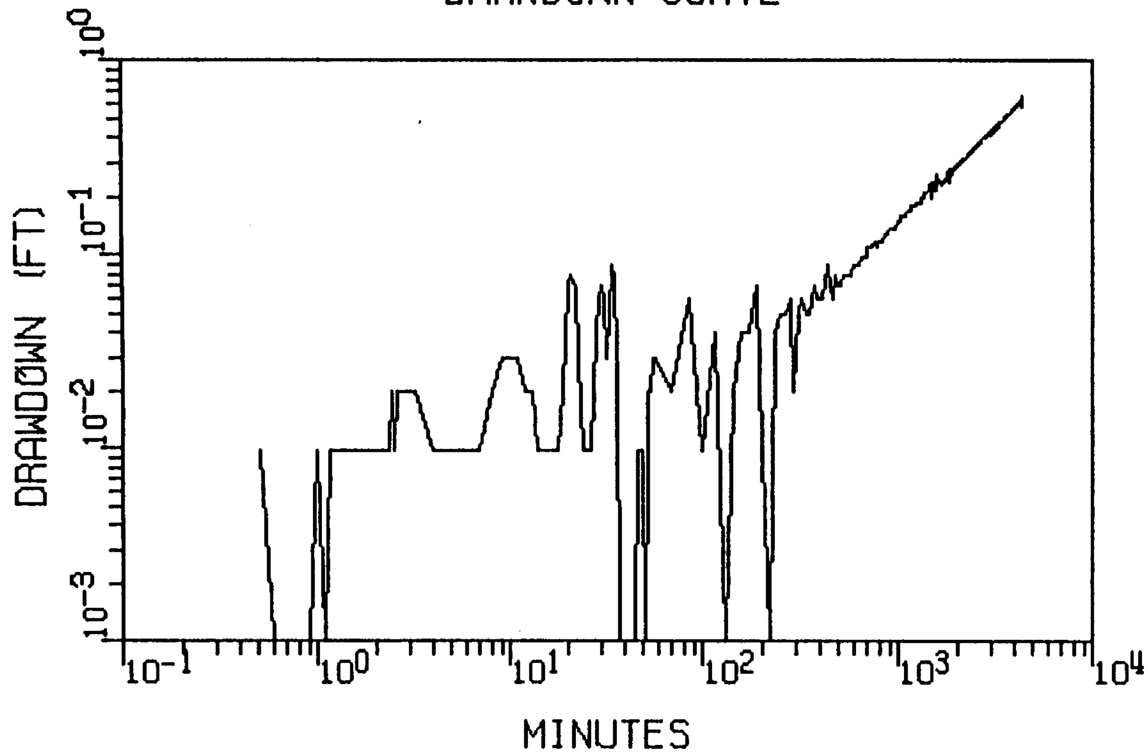


PADUCAH PUMPING TEST
DRAWDOWN CURVE
BACKGROUND FLUCTUATION PRIOR
TO INFLUENCE OF PUMPING
DRAWDOWN (FT)
MINUTES

PZ-5S

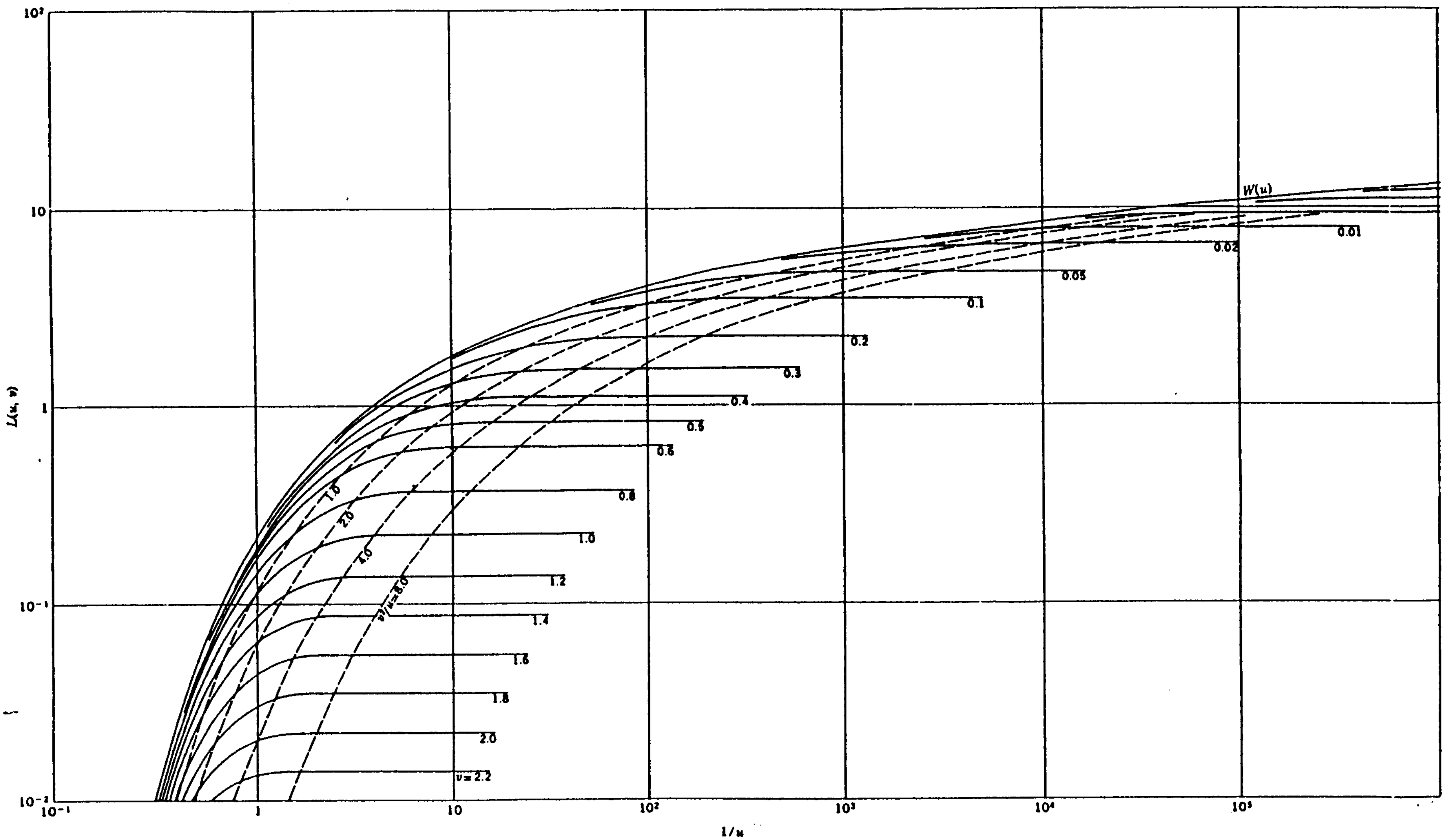
PADUCAH PUMPING TEST

DRAWDOWN CURVE



PW-1 DEFUNCT

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

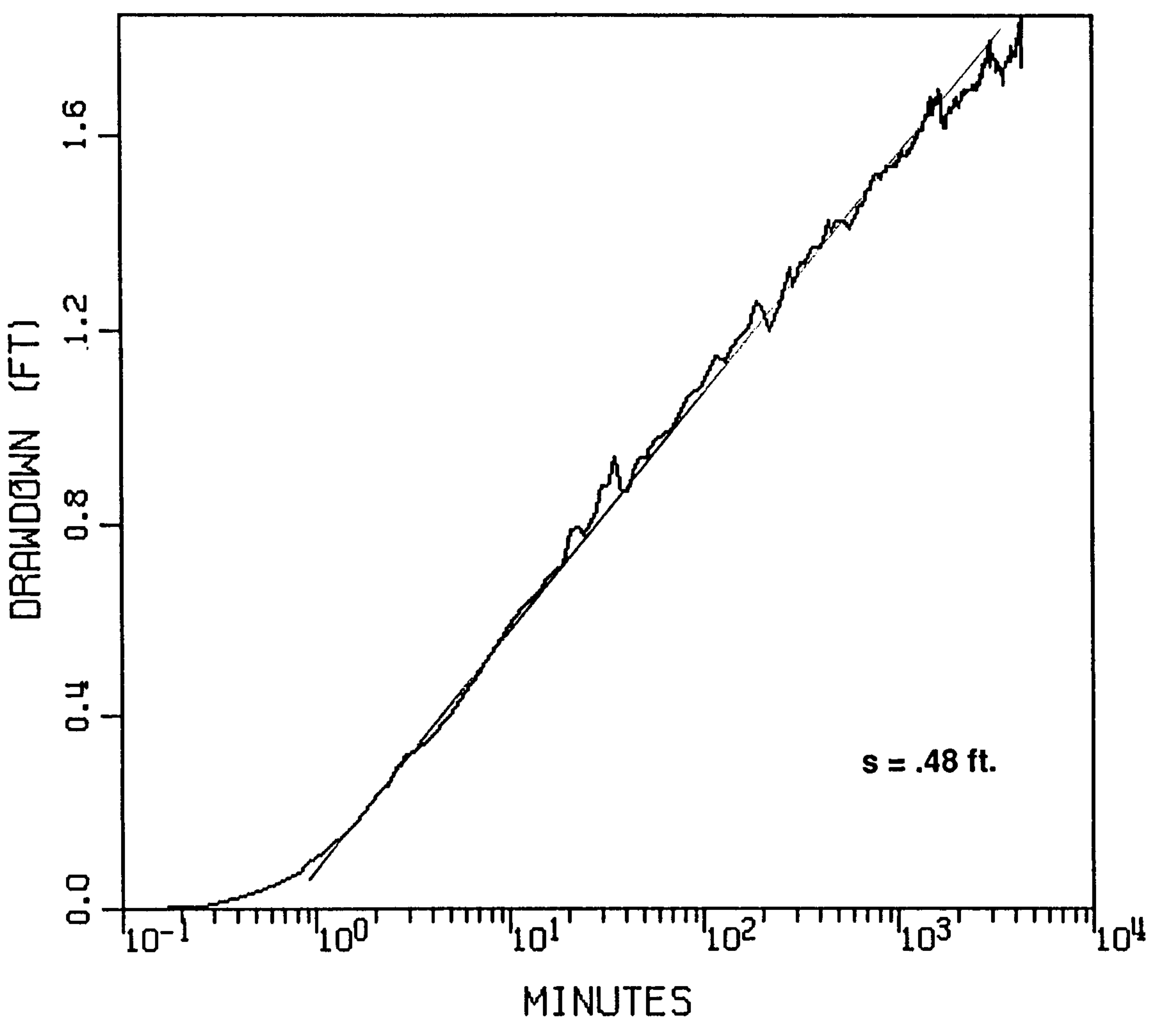


TYPE CURVES

1/u

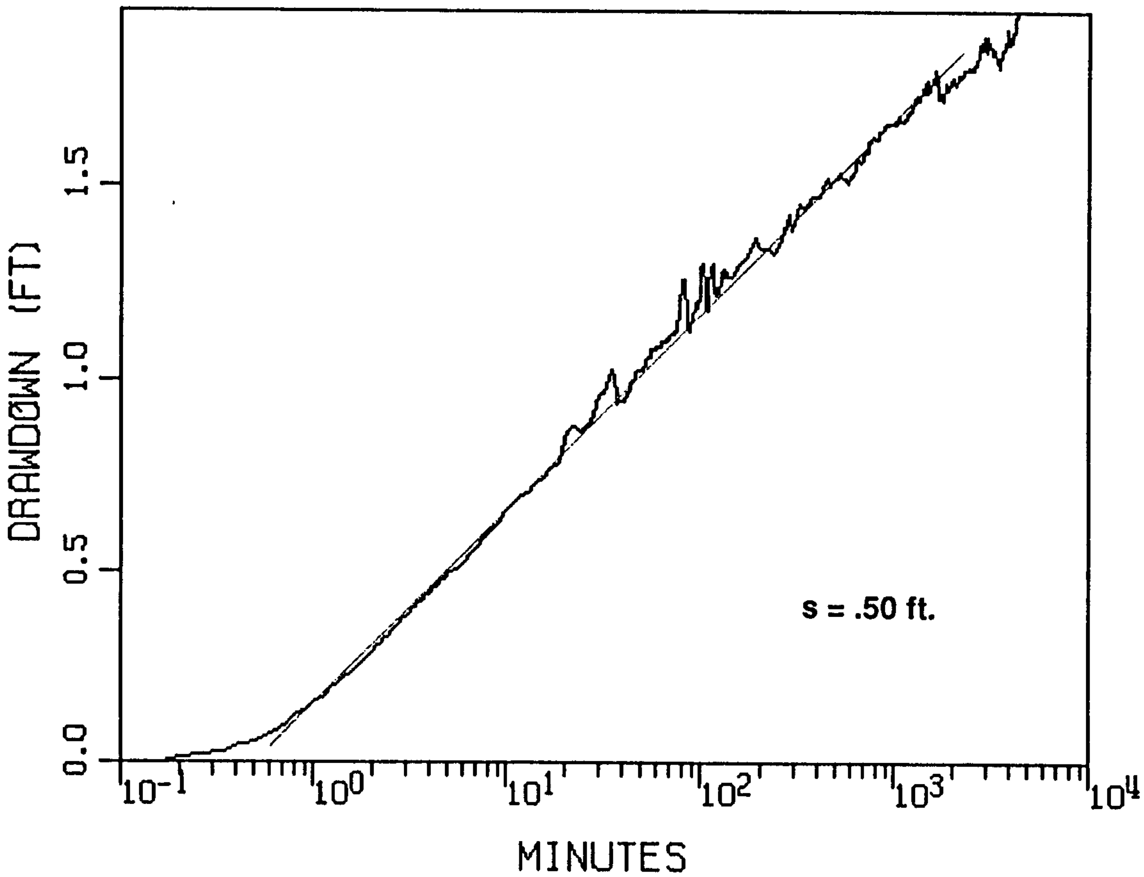
Attachment E
SEMI-LOG DRAWDOWN CURVES

PADUCAH PUMPING TEST
SEMILOG DRAWDOWN CURVES
CORRECTED FOR BAROMETRIC



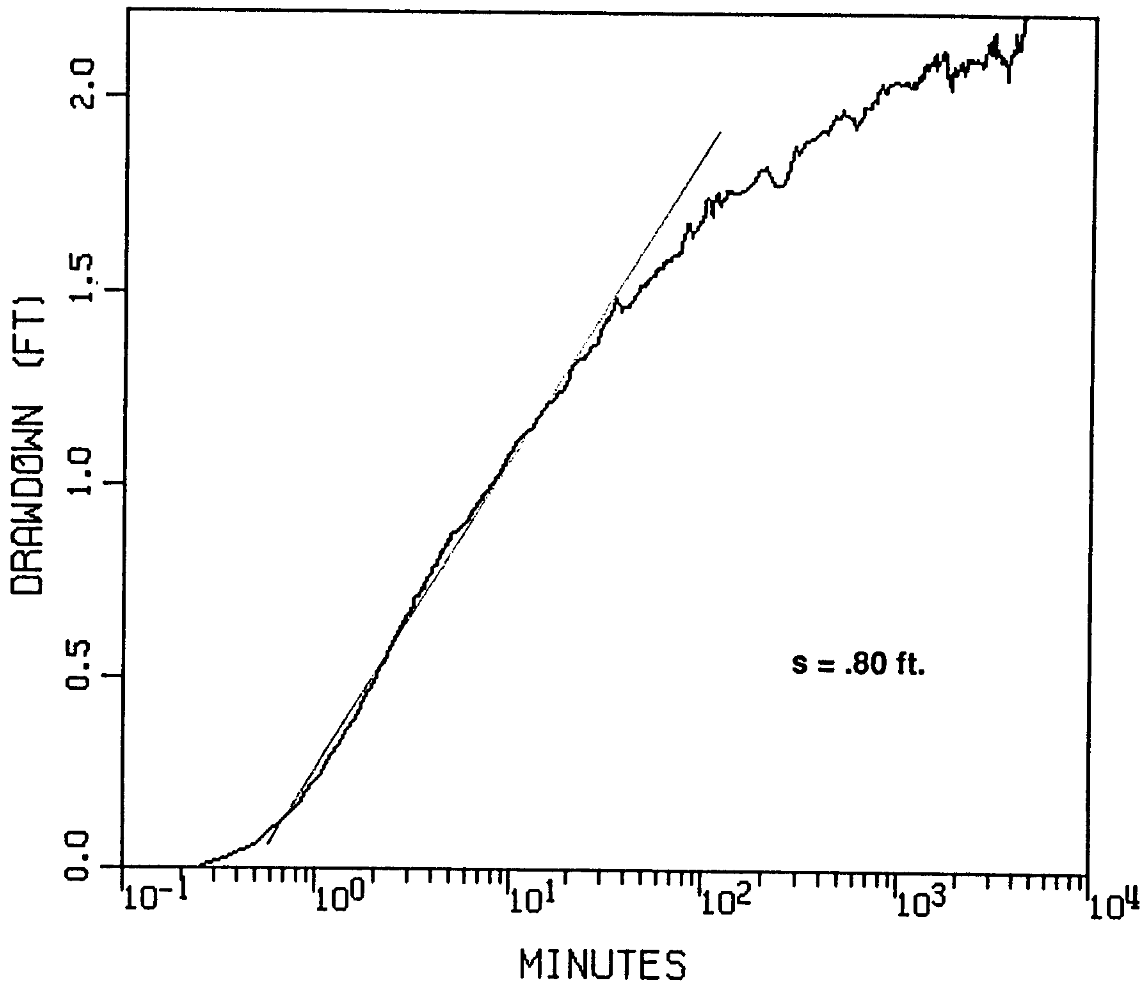
PZ-1G CORRECTED

PADUCAH PUMPING TEST
SEMILOG DRAWDOWN CURVES
CORRECTED FOR BAROMETRIC

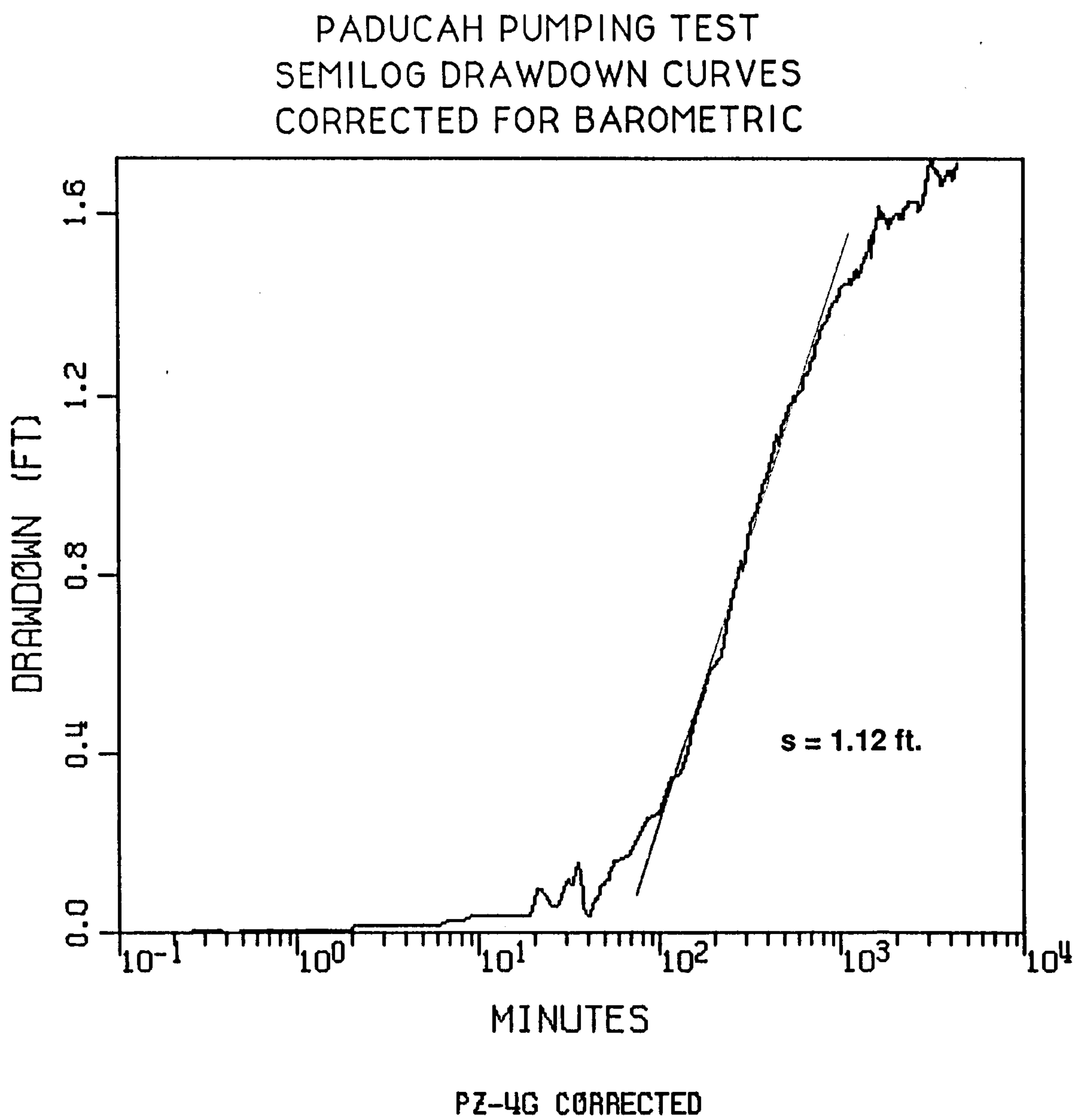


PZ-2G CORRECTED

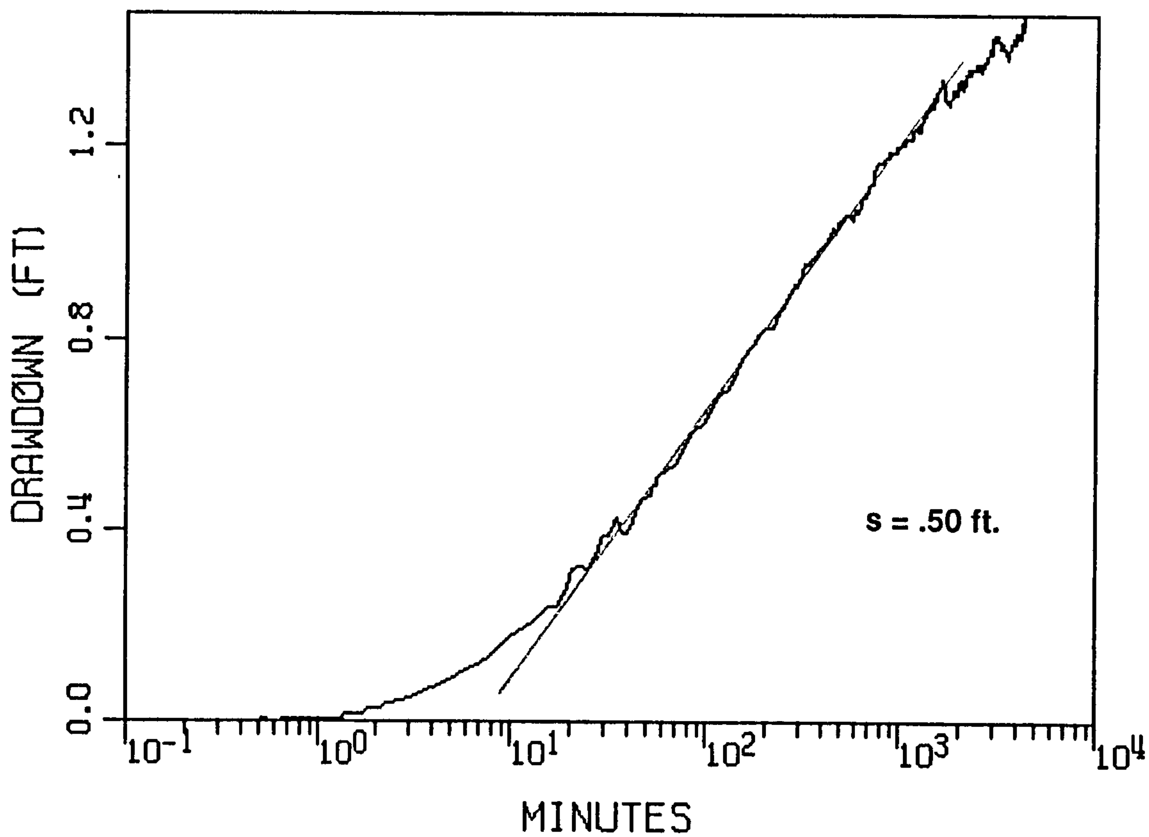
PADUCAH PUMPING TEST
SEMILOG DRAWDOWN CURVES
CORRECTED FOR BAROMETRIC



PZ-3G CORRECTED

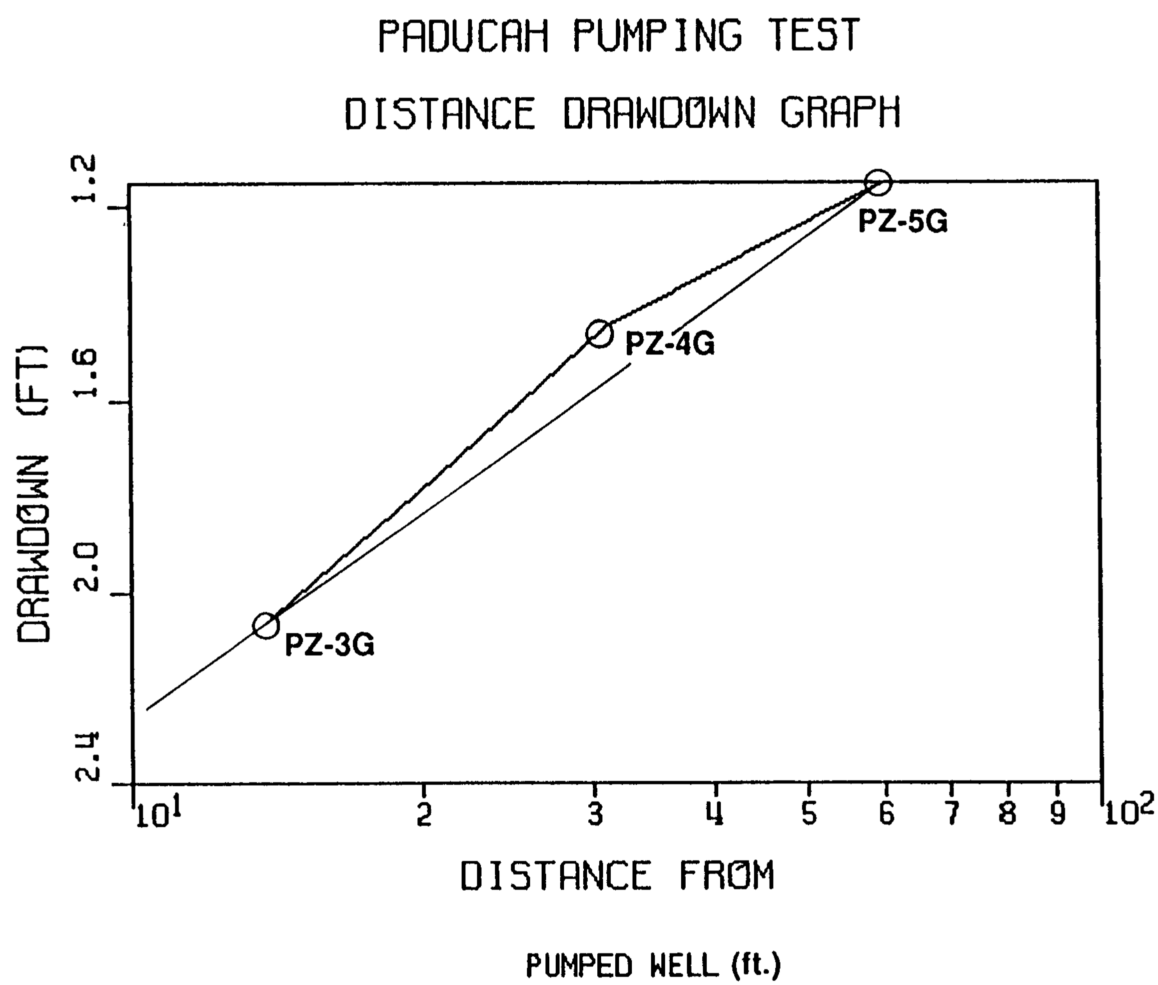

PADUCAH PUMPING TEST
SEMILOG DRAWDOWN CURVES
CORRECTED FOR BAROMETRIC
DRAWDOWN (FT)
0.0
0.4
0.8
1.2
1.6
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
MINUTES
s = 1.12 ft.
PZ-4G CORRECTED

PADUCAH PUMPING TEST
SEMILOG DRAWDOWN CURVES
CORRECTED FOR BAROMETRIC



PZ-5G CORRECTED

Attachment F
DISTANCE DRAWDOWN PLOT


PADUCAH PUMPING TEST
DISTANCE DRAWDOWN GRAPH
DRAWDOWN (FT)
1.2
1.6
2.0
2.4
PZ-5G
PZ-4G
PZ-3G
10^1
2
3
4
5
6
7
8
9
10^2
DISTANCE FROM
PUMPED WELL (ft.)

Attachment G

ANISOTROPY OUTPUT AND MODEL DESCRIPTION

P A P A D O P   V2.1

Directional Permeability Analysis

IN-SITU INC. SOFTWARE SERIES

PADUCAH

Flow rate = 92.00 gpm

Well #	X (ft)	Y (ft)	Match Point Time (min)	Match Point Drawdown (ft)	Match Point U	Match Point W(U,R/B)	R/B
1	31.00	15.00	4.20E-01	2.20E-01	1.00E+00	1.00E+00	2.00E-02
2	-23.00	5.00	2.60E-01	2.20E-01	1.00E+00	1.00E+00	1.00E-02
3	10.00	-10.00	7.50E-01	2.40E-01	1.00E-01	1.00E+00	2.00E-02
4	10.00	-60.00	4.00E+00	2.40E-01	1.00E+00	1.00E+00	4.00E-02

Well #	T (gpd/ft)	S
1	47920.11	6.30E-03
2	47920.11	8.35E-03
3	43926.77	6.12E-03
4	43926.77	1.76E-02

SUMMARY OF RESULTS - 3 WELL COMBINATIONS

Well No.	T-major (gpd/ft)	T-minor (gpd/ft)	T-mean (gpd/ft)	Angle of T-major (degrees)	Storage Coeff.
1 2 3	80325.95	26976.62	46550.22	78.4	4.70E-03
1 2 4	85571.75	25322.88	46550.22	13.8	1.02E-02
1 3 4	Probably heterogeneous media				
2 3 4	1.06E+05	1.93E+04	4.52E+04	-32.2	1.21E-02

INTERVAL (deg)	FREQUENCY
-90.0 - -60.0	0
-60.0 - -30.0	1
-30.0 - .0	0
.0 - 30.0	1

30.0	-	60.0	0
60.0	-	90.0	1

RESULTS OF LEAST SQUARES FIT

Major Transmissivity	= 65408.65 gpd/ft
Minor Transmissivity	= 32181.93 gpd/ft
Mean Transmissivity	= 45880.02 gpd/ft
Direction of Major Transmissivity	= -3.12 degrees
Storage Coefficient	= 7.79E-03

Well #	Leakage factor (ft)	Aquitard K/b (gpd/ft/ft**2)
1	1.61E+03	1.78E-02
2	2.00E+03	1.15E-02
3	7.16E+02	8.96E-02
4	1.79E+03	1.43E-02

PAPADOP COMPLETED

Theory Behind the Model

Papadopulos (1965) gives the equation for drawdown in an infinite, confined aquifer that is fully penetrated by a well flowing at constant rate:

$$s = \frac{Q}{4\pi\sqrt{T_{xx}T_{yy} - T_{xy}^2}} W(u_{xy}), \tag{1}$$

where

$$u_{xy} = \frac{S}{4t}\left(\frac{T_{xx}y^2 + T_{yy}x^2 - 2T_{xy}xy}{T_{xx}T_{yy} - T_{xy}^2}\right). \tag{2}$$

and
Q is the flow rate,
t is the time since flow started,
s is the drawdown,
S is the storage coefficient,
T_{xx}, T_{yy}, T_{xy} are components of the transmissivity vector,
x,y are coordinates of an orthogonal axis having its origin at the well
W(u) is the well function.

Substituting the definition of u_{xy} from the well-known Theis exponential integral solution

$$u_{xy} = \frac{r_i^2 S_i}{4T_i t} \tag{3}$$

Into equation 2 for 3 values of i (corresponding to 3 observation wells) allows us to solve for the three unknowns, T_{xx}, T_{yy}, and T_{xy}. The variable r_i in equation 3 represents the distance from the pumping well to observation well i.

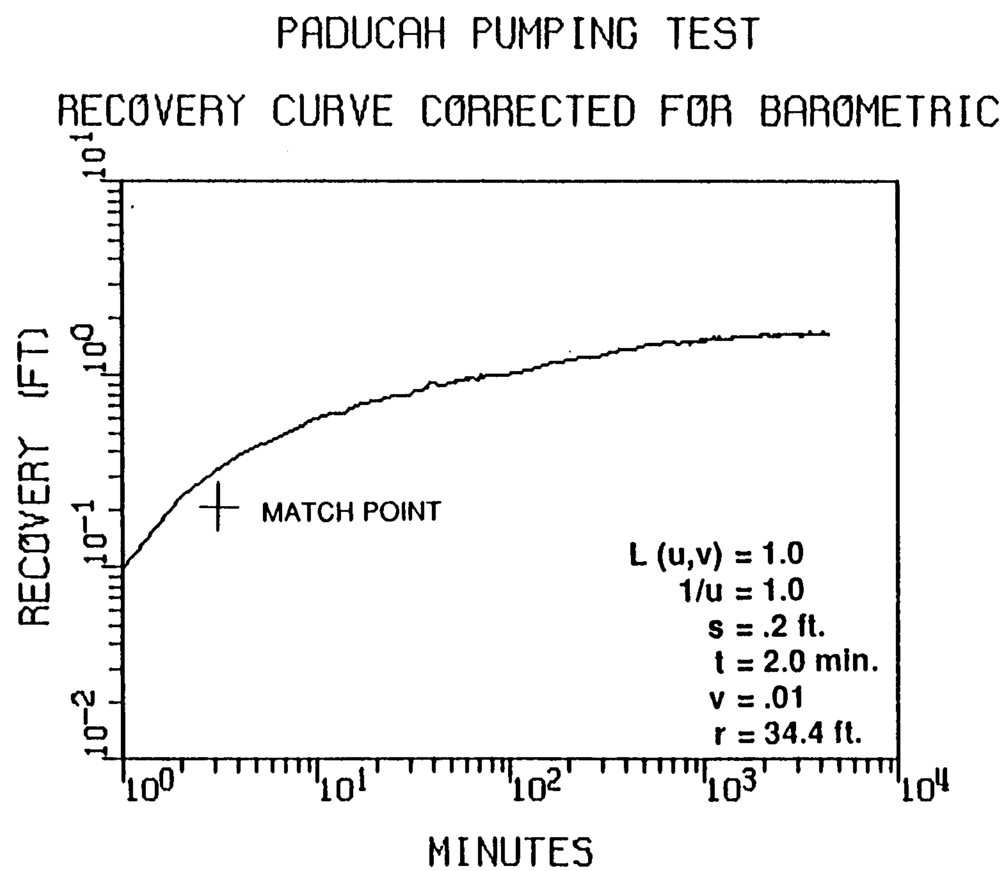
Once T_{xx}, T_{yy}, and T_{xy} have been obtained, a transformation is employed to find the principal transmissivities, $T_{\xi\xi}$ and $T_{\eta\eta}$, as well as the angle between the x-axis and the ξ-axis, θ:

$$T_{\xi\xi} = \frac{1}{2}\left\{\left[T_{xx} + T_{yy}\right] + \left[\left(T_{xx} - T_{yy}\right)^2 + 4T_{xy}^2\right]^{1/2}\right\} \tag{4}$$

$$T_{\eta\eta} = \frac{1}{2}\left\{\left[T_{xx} + T_{yy}\right] - \left[\left(T_{xx} - T_{yy}\right)^2 + 4T_{xy}^2\right]^{1/2}\right\} \tag{5}$$

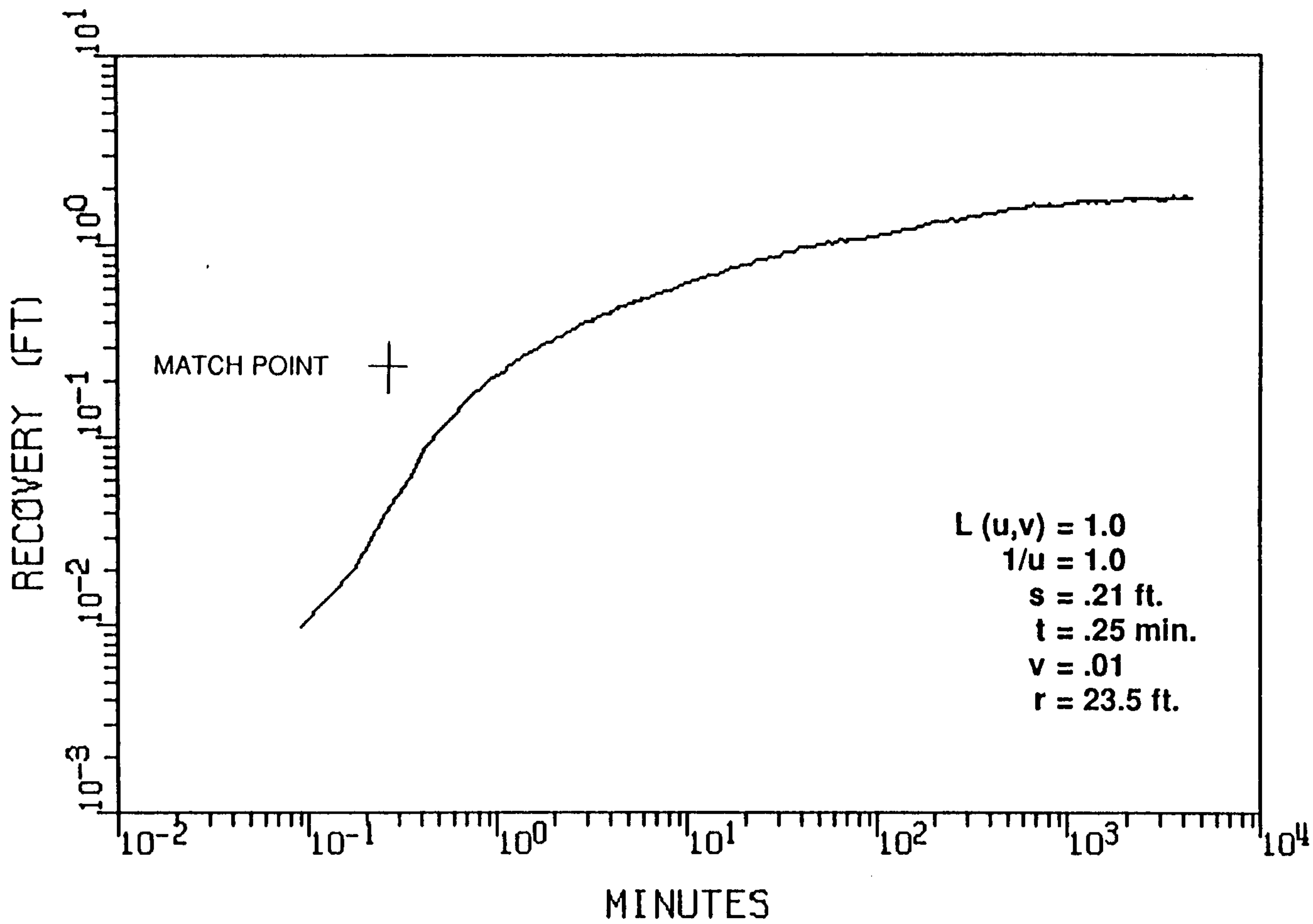
$$\theta = \arctan\left(\frac{T_{\xi\xi} - T_{xx}}{T_{xy}}\right) \qquad 0 \le \theta < \pi \tag{6}$$

Attachment H
RECOVERY CURVES



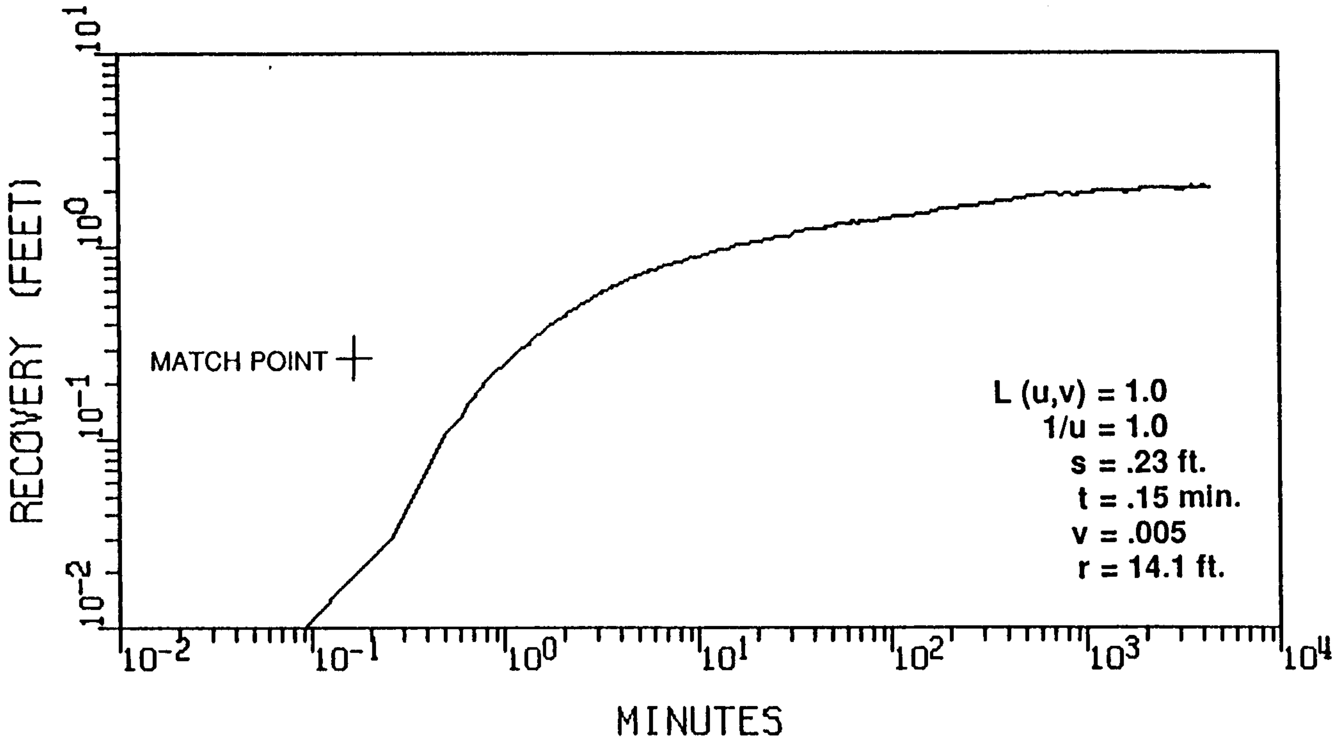
PZ-1G CORRECTED

PADUCAH PUMPING TEST
RECOVERY CURVE CORRECTED FOR BAROMETRIC



PZ-2G CORRECTED

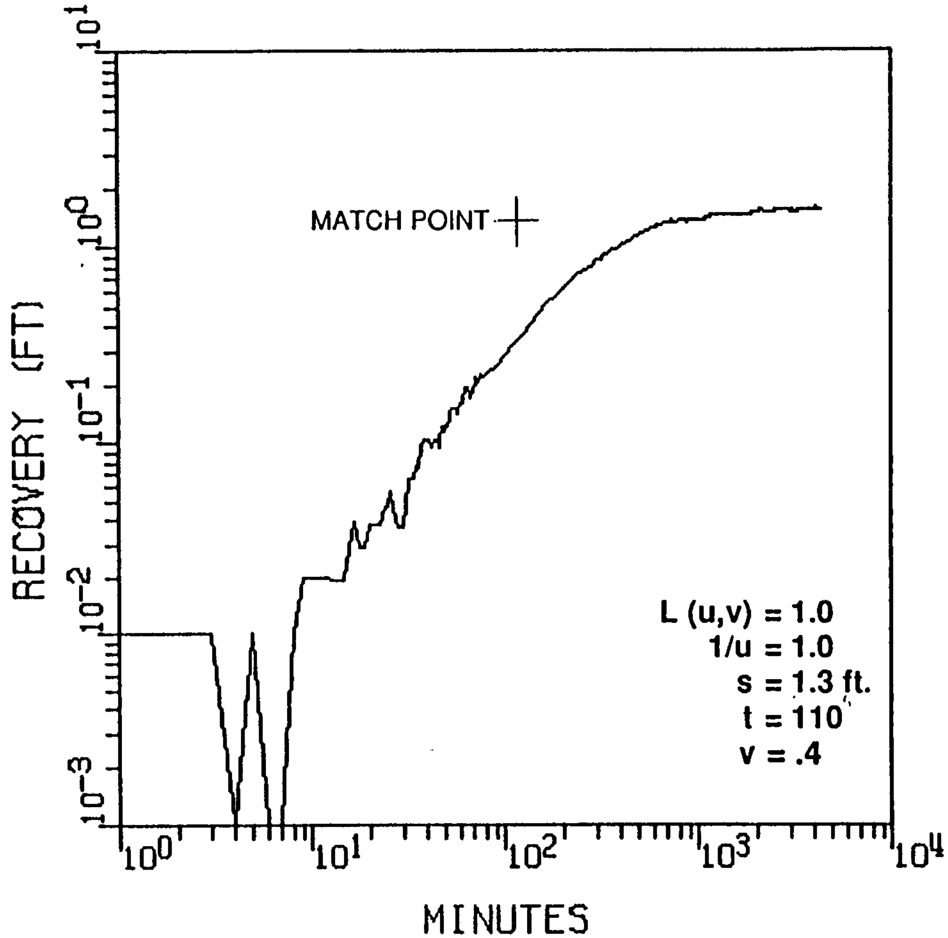
PADUCAH PUMPING TEST
RECOVERY CURVE CORRECTED FOR BAROMETRIC



PZ-3G CORRECTED

PADUCAH PUMPING TEST

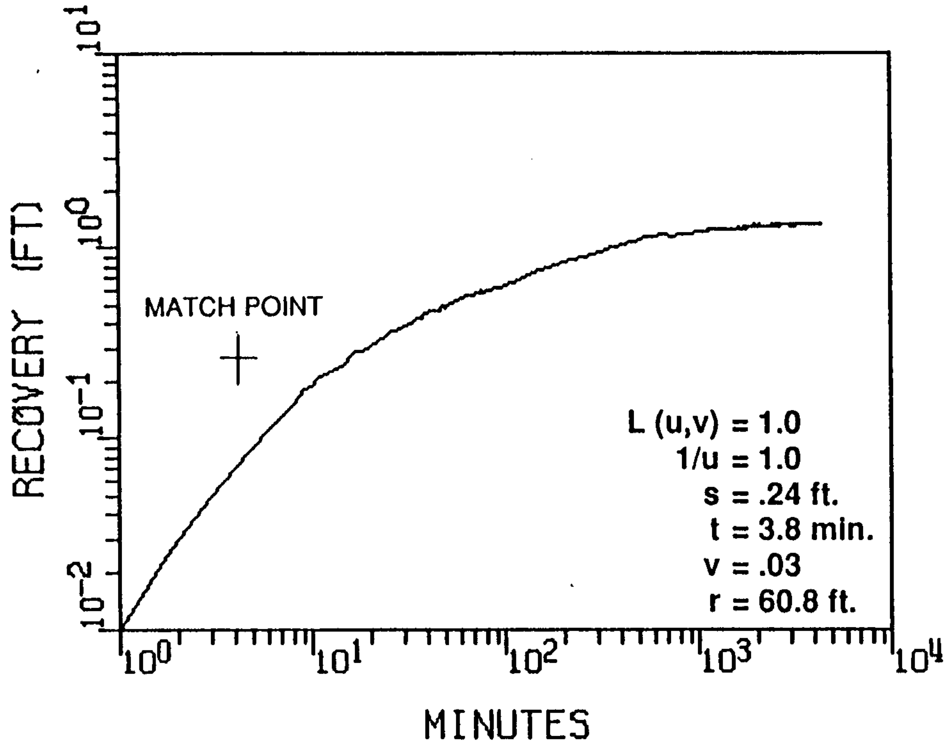
RECOVERY CURVE CORRECTED FOR BAROMETRIC



PZ-4G CORRECTED

PADUCAH PUMPING TEST

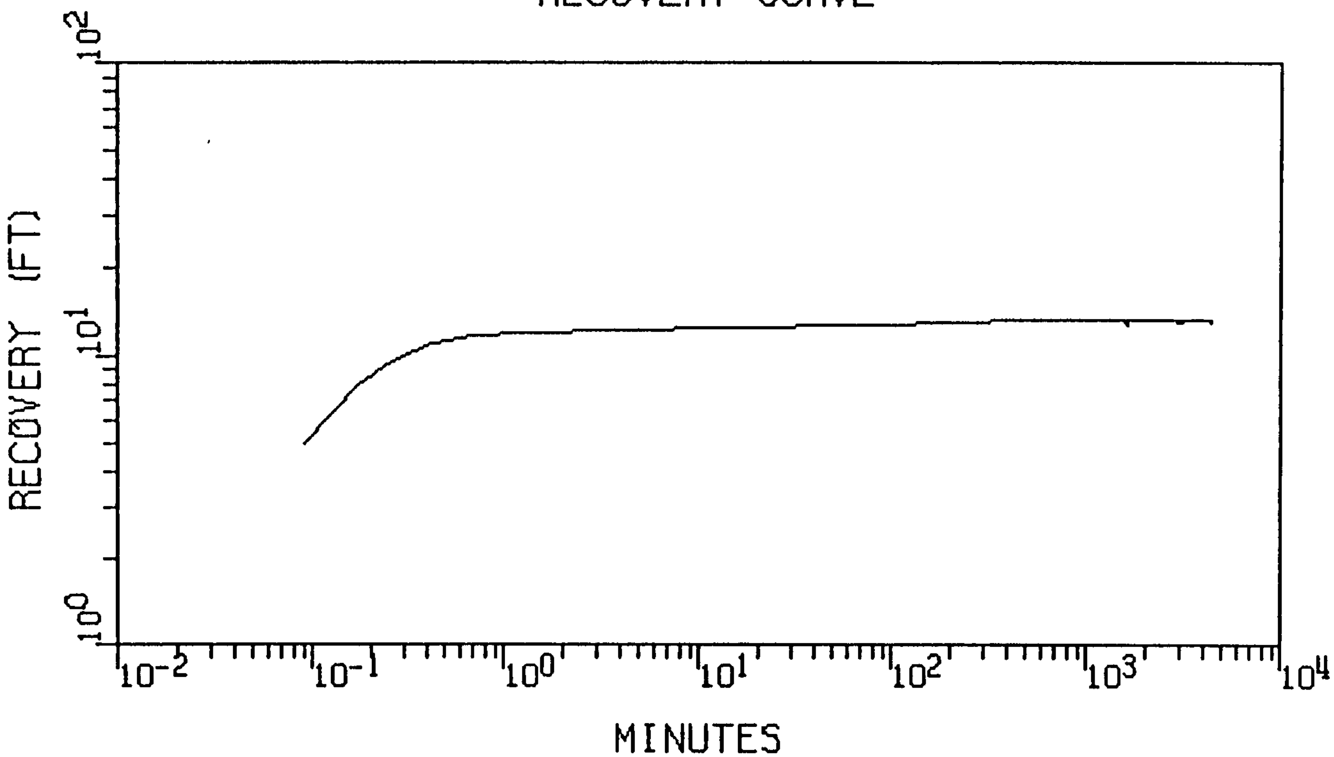
RECOVERY CURVE CORRECTED FOR BAROMETRIC



PZ-5G CORRECTED

PADUCAH PUMPING TEST

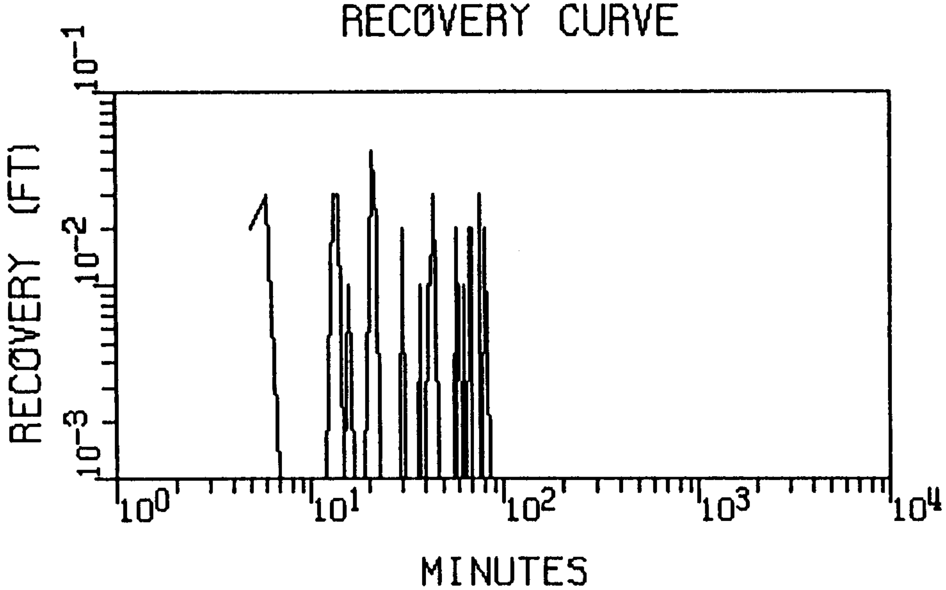
RECOVERY CURVE



PW-1

PADUCAH PUMPING TEST

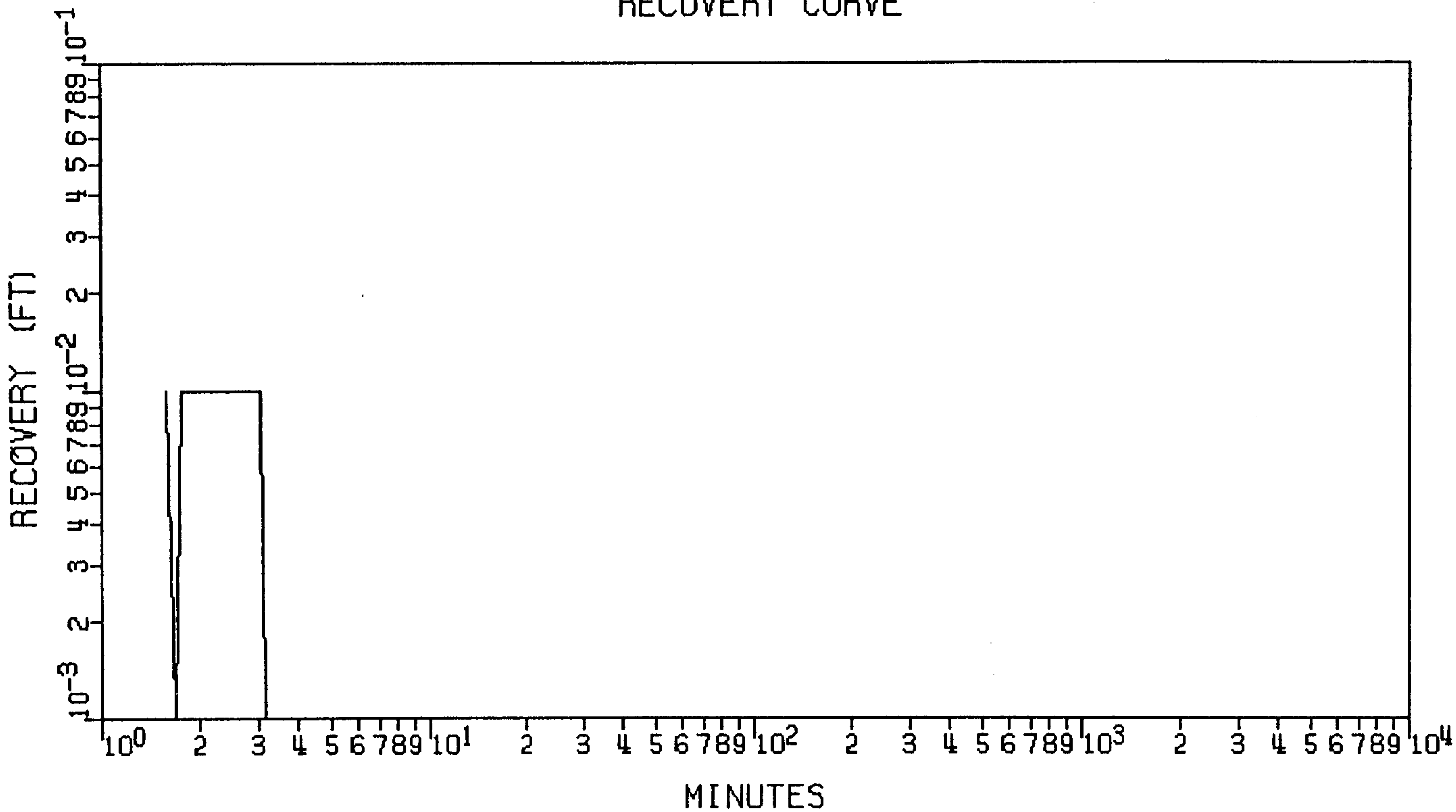
RECOVERY CURVE



PW-1 DEFUNCT

PADUCAH PUMPING TEST

RECOVERY CURVE



PZ-3S

PADUCAH PUMPING TEST

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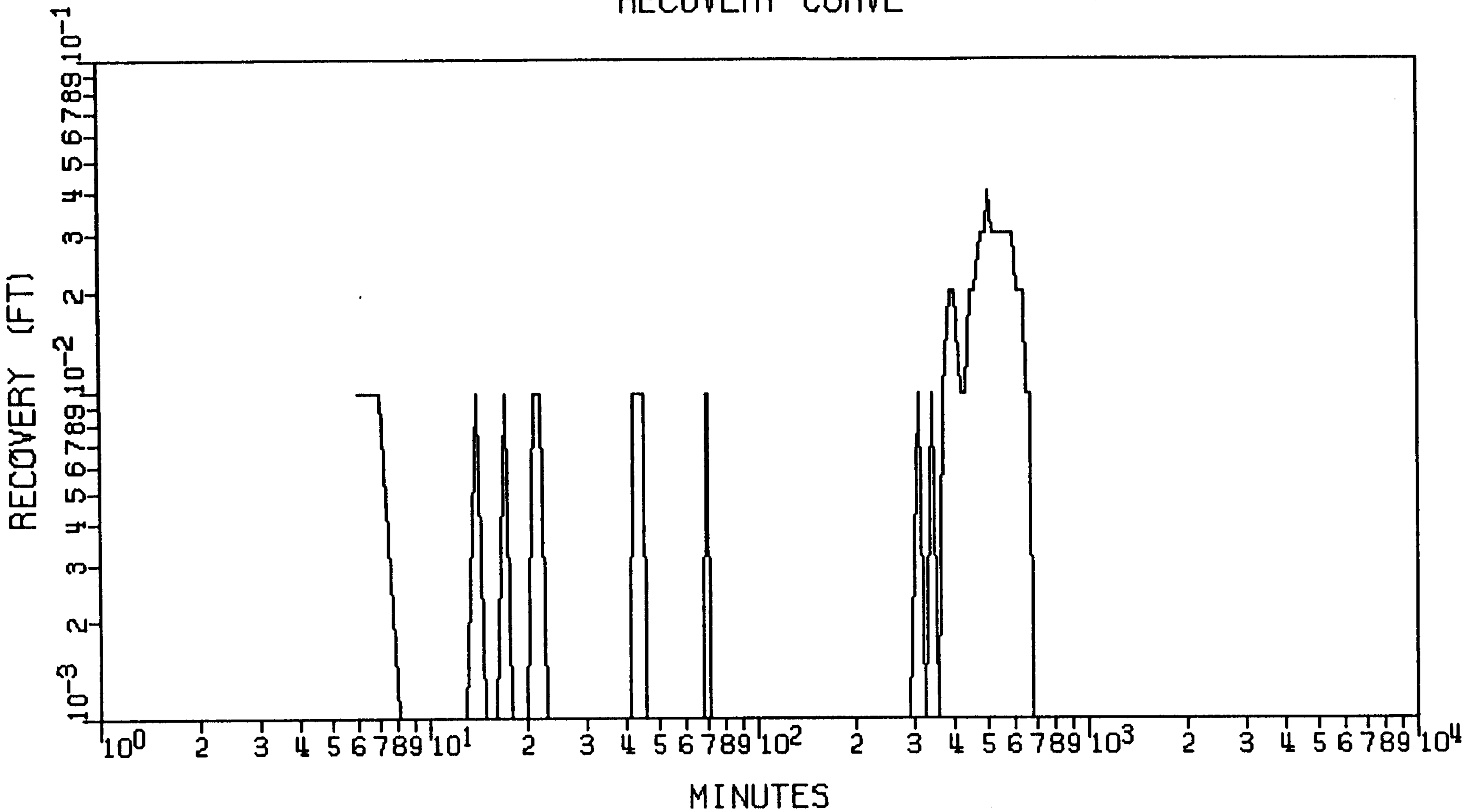

PZ-4S

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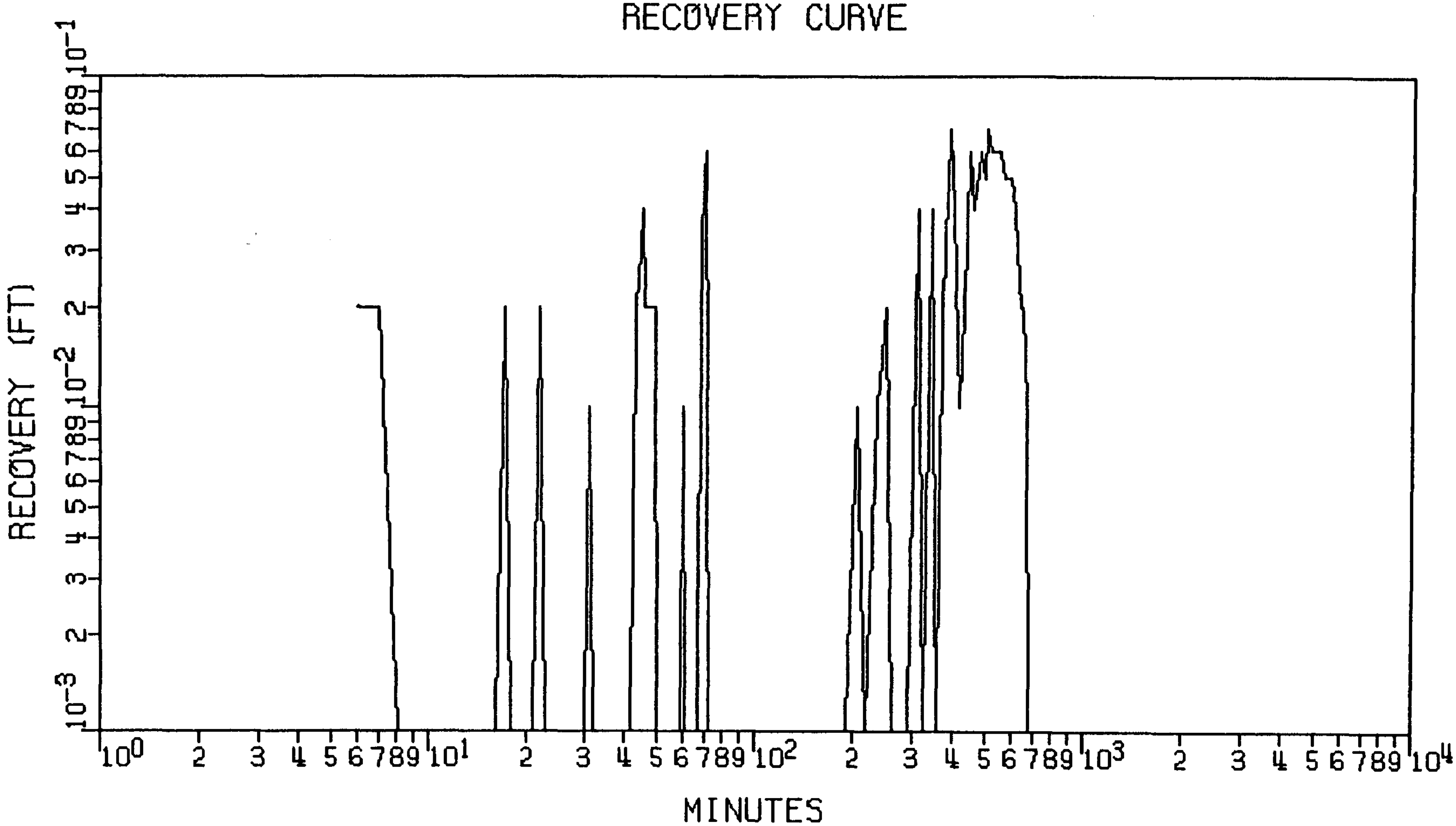
RECOVERY CURVE



PZ-5S

PADUCAH PUMPING TEST

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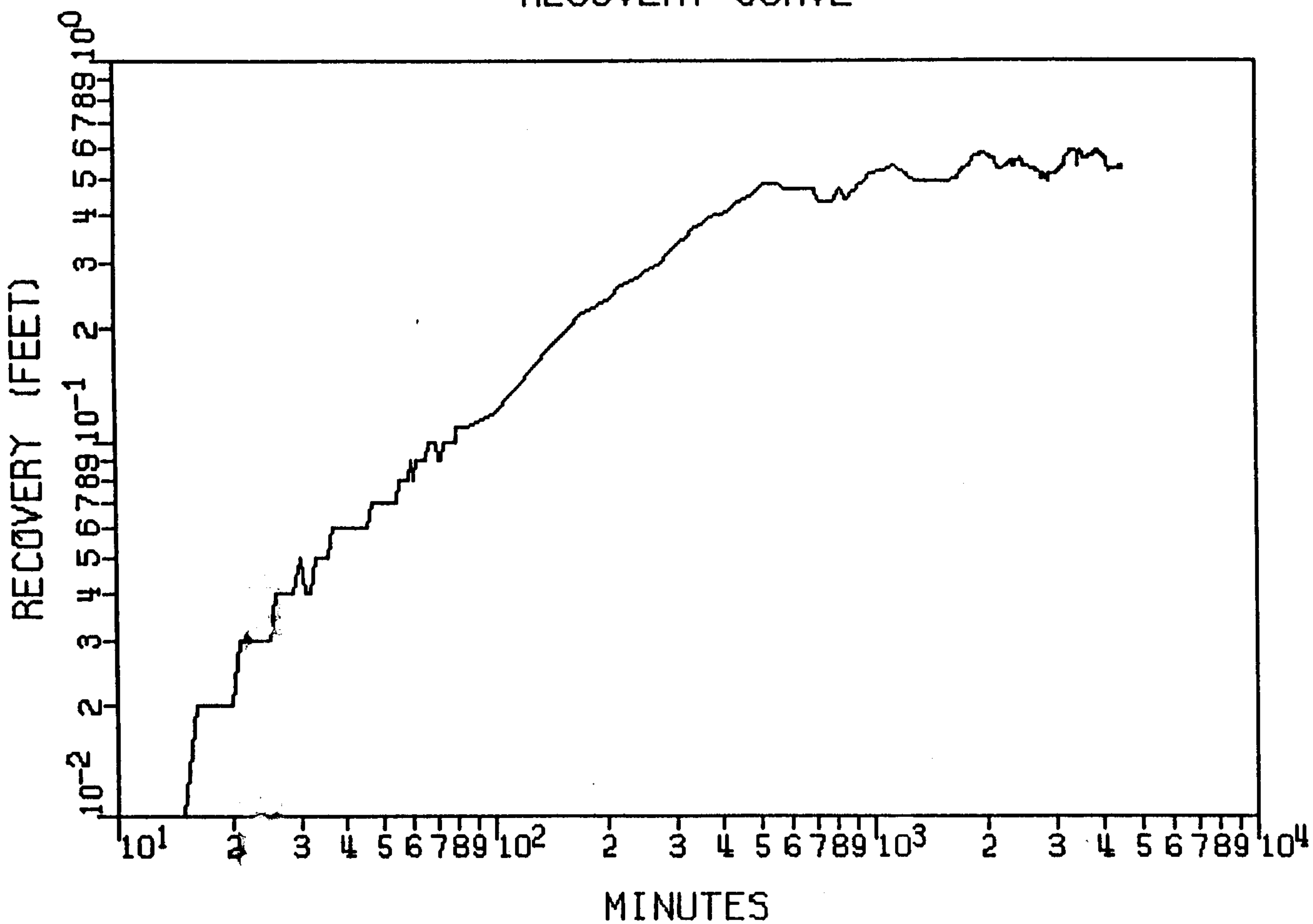
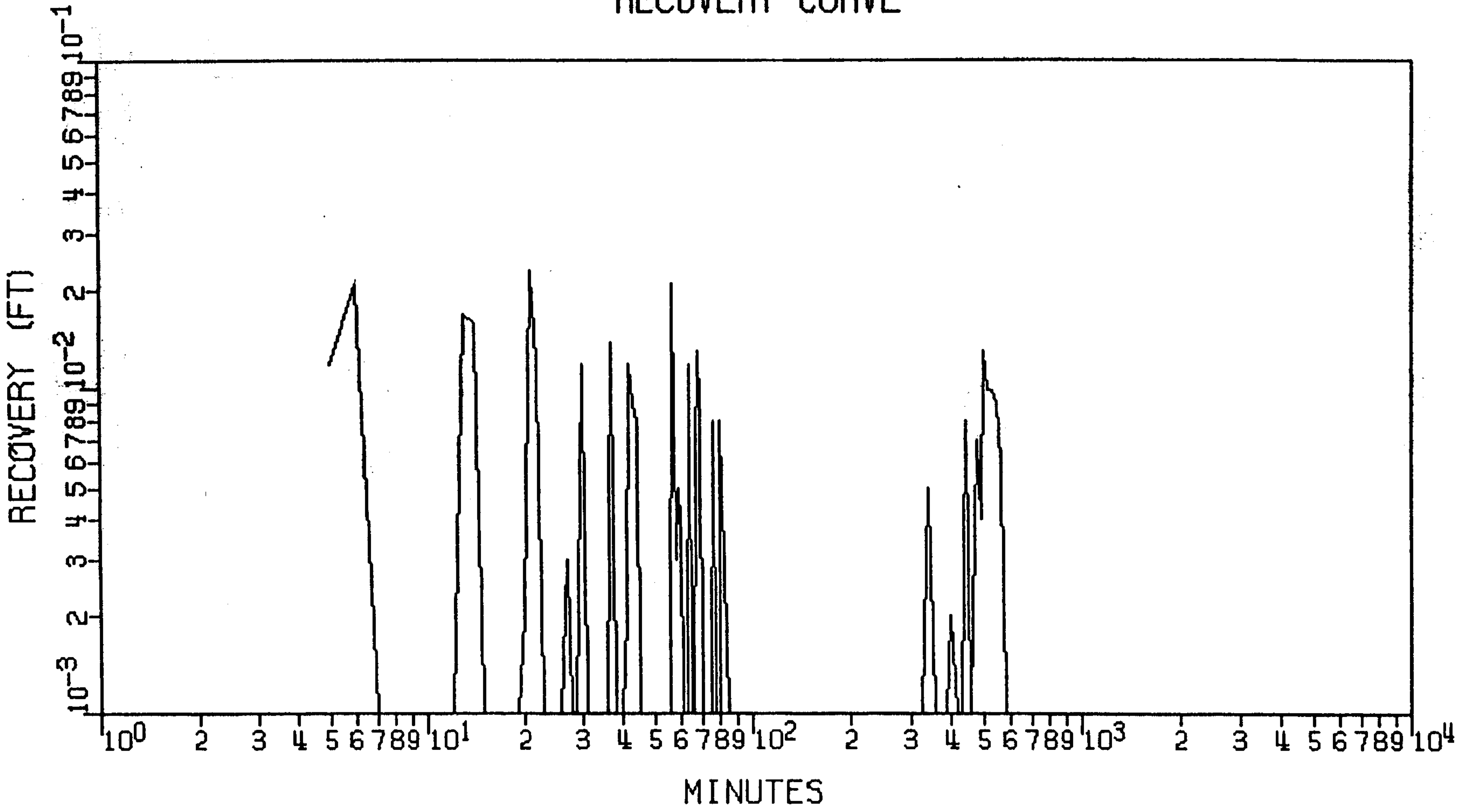


MW-165

PADUCAH PUMPING TEST

RECOVERY CURVE



MW-166